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for the degree of Doctor of Philosophy

The Role of Impulsive Processes in Self-Determination Theory: Investigating the Effects of Implicit and Explicit Measures of Motivation Across a Range of Behaviours

Abstract

The current thesis reports six studies investigating the predictive validity and effects of implicit and explicit measures of motivation from self-determination theory (SDT; Deci & Ryan, 2008; Edmunds, Ntoumanis, & Duda, 2007; Ryan & Deci, 2000b), across a range of behaviours. In addition, the suitability of a dual-systems model (Strack & Deutsch, 2004) as a conceptual framework to understand the effects of implicit and explicit measures of motivation is also addressed. The research in this thesis, which focuses on integrating implicit processes and self-determination theory literature, was a novel area at the commencement of research. Therefore, the research conducted is of central importance in adding to the literature by examining the effects of implicit processes on motivation, thereby providing a better overall picture and adding knowledge by incorporating implicit processes alongside explicit measure from SDT.

In the first study, implicit measures of motivation were used to test whether autonomous and controlled forms of motivation could be measured separately at the implicit level. This study advanced knowledge of the processes by which different forms of motivation from SDT influence behaviour by comparing the predictive validity of explicit measures of motivation and a newly developed implicit measure of motivation from SDT for 20 health-related behaviours. A dual-systems model was adopted to explain the process by which implicitly-measured motivation from SDT provided unique prediction of behaviour above explicit measures. Separate structural

equation models of the proposed model for each behaviour indicated some support for the role of implicit measures of motivation; however, intention provided more consistent, significant prediction across most behaviours.

Following on from the results of the first study, a second study was conducted to assess the predictive validity of an alternative implicit measure of motivation from SDT in explaining variance in three health-related behaviours (condom use, healthy-eating, and physical activity). The implicit association test was adopted to develop a measure of implicit forms of motivation from SDT due to its increased support in the wider-literature (Greenwald, Nosek, & Banaji, 2003). Interactions between implicit and explicit measures of motivation were also analysed consistent with Perugini's (2005) proposal of an interaction or *multiplicative* pattern of effects for the implicit and explicit processes. Consistent with Perugini's proposal, the dual-systems model also outlines that the two systems may interact; therefore, directly testing this was necessary. Results indicated that only implicitly-measured motivation predicted physical activity, whereas explicit measures significantly predicted physical activity, healthy eating, and condom use.

Based on the findings from the first two studies, and other research conducted in the wider-literature (Perugini, 2005; Perugini, O'Gorman, & Prestwich, 2007), there was increasing support for the view that the predictive validity of implicit measures may be biased towards behaviours that are more spontaneous or unplanned in their initiation. Chapter 4 outlines two studies that

were conducted to test the predictive validity of implicit measures of motivation from SDT for novel behaviours with which participants had little or no previous experience and administered without their prior knowledge, therefore, not allowing them the chance to plan or prepare. Results showed that the implicit measure of motivation significantly predicted both behaviours. These studies, when taken in conjunction with the prior studies, also provided insight into the double-dissociation pattern of effects between implicit and explicit measures. Essentially, it may be that implicit measures of motivation better predict spontaneous behaviours, whilst explicit measures of motivation better predict planned or deliberative behaviours.

A further study was conducted into the role of implicit motivation in students' academic achievement (Chapter 5). This provided a stringent test of the predictive validity of the implicit measure of motivation, as it was administered at the beginning of the academic years and used to predict students' grades (taken as an indicator of behavioural engagement with academic work) at the end of the year. Given the findings from previous studies (e.g., Burton, Lydon, D'Alessandro, & Koestner, 2006), motivation for different academic behaviours (e.g., studying throughout the year, revision for exams, and coursework) was measured. Results indicated that implicitly measured motivation consistently predicted grades at the end of the year.

The final study of the thesis focused on another pertinent issue in psychometric assessment. Self-report measures of individuals' motivation and

other psychological constructs have been shown to affect subsequent behaviour, frequently referred to as the *mere-measurement effect* (Conner, Godin, Norman, & Sheeran, 2011; Godin et al., 2010). While this effect has been shown for explicit measures, an important outstanding question is whether the same effect generalises to implicit measures. Given increases in the use of implicit measures in research on motivation, this issue is important to consider in research. A Solomon (1949) four-group design was adopted to investigate the possibility of implicit measures of motivation affecting subsequent interventions, and behaviour. Results showed that completion of an implicit measure of motivation significantly decreased behavioural engagement. Furthermore, a significant interaction between implicit measurement and priming manipulations indicates the possibility of a suppression effect, such that the relative implicit measure of autonomous and controlled motivation lowers the effect of a prime for autonomous motivation.

In the concluding chapter (Chapter 7) findings from the empirical studies reported in the thesis in terms of the wider research area is discussed. Firstly, the role of implicit measures of motivation appears to predict behaviours that are spontaneous, or unplanned, while explicit measures better predict planned or deliberate behaviours. This distinction fits within the wider literature on the patterns of implicit and explicit processes (see Perugini, 2005). Secondly, some limited support is shown throughout the chapters for a dual-systems model as a conceptual framework for explicit and implicit, or reflective and impulsive processes. Furthermore, the limitations and scope of

the studies reported in the thesis are outlined and suggestions for future research based on the research provided.

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Contents

Tables and Figures

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Chapter 1: Introduction

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Background to the thesis

The majority of research into individuals' motivated, goal-directed behaviour has focused on deliberative, reflective processes and decision making (Ajzen, 1991, 2002; Chatzisarantis & Hagger, 2009; Fishbein & Ajzen, 2009; Hagger & Chatzisarantis, 2009; Hagger, Chatzisarantis, & Biddle, 2002; Hardeman et al., 2002; Silva et al., 2008). This approach usually incorporates assessment of linking motivation to behavioural engagements through the use of self-report measures and associated socio-cognitive constructs. However, not all behaviours are planned or the result of deliberative goal-setting; therefore, using only explicit measures may not always provide a complete picture of the motivational antecedents underlying behaviour. In order to address this issue, the recent inception of implicit measures has sought to extend knowledge of the processes than underpin behaviour (Banse & Greenwald, 2007; Banting, Dimmock, & Lay, 2009; Bargh & Ferguson, 2000; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001; Greenwald et al., 2002), including motivated behaviour (Bargh & Gollwitzer, 1994; Kawada, Oettingen, Gollwitzer, & Bargh, 2004; Levesque, Copeland, & Sutcliffe, 2008; Levesque & Pelletier, 2003; Sheeran et al., 2005). Self-determination theory, a comprehensive theory of human motivation, has received considerable attention in the literature and has begun to be complemented with implicit measures (Levesque & Brown, 2007; Levesque et al., 2008; Levesque & Pelletier, 2003). To provide a better understanding of the role of implicit and explicit processes in motivation and behaviour, several variants of dual-systems models (e.g., Back, Schmulke, & Egloff, 2009; Fazio & Towles-

Schwen, 1999; Strack & Deutsch, 2004; Wilson, Lindsey, & Schooler, 2000) have been proposed.

Justifying the research question

Implicit measures of attitudes, such as the implicit association test (IAT; Greenwald, McGhee, & Schwartz, 1998) have been incorporated into a range of research focusing on attitudes toward a range of behaviours (e.g., Czopp, Monteith, Zimmerman, & Lynam, 2004; Greenwald et al., 2002; Maison, Greenwald, & Bruin, 2004). However, there were very few articles that had developed an implicit measure of motivation. Self-determination theory (SDT; Deci & Ryan, 2008; Edmunds, Ntoumanis, & Duda, 2007; Ryan & Deci, 2000b), a comprehensive meta-theory of human motivation, has begun to be augmented with developments in measuring implicit variables (Levesque et al., 2007; Levesque & Brown, 2007). The first aim of the current thesis was therefore to provide a more detailed account of the role of implicit processes in motivation and behaviour. More specifically, to assess the extent to which implicit and explicit forms of motivation affect behavioural engagement and overall performance. Concepts from SDT were used to inform the development of implicit measures of motivation, which were then used to predict a range of behaviours in different contexts. In addition, a further aim was to assess the extent to which a dual-systems model could account for the unique and combined effects of implicit and explicit measures of motivation on the prediction of behaviour. One particular variant of dual-systems model, Strack and Deutch's (2004) reflective-impulsive model (RIM), was adopted due to its

parsimonious account of the two systems of motivation as a determinants of behavioural engagement.

The current thesis makes an important contribution to knowledge and advances understanding of the motivational processes that underpin motivated behaviour by testing key hypotheses of the role of implicit measures of motivation on behaviour, particularly health-related behaviours, and the suitability of a leading dual-systems model as a conceptual framework to understand the process by which these implicit measures affect behaviour.

Self-determination theory

Self-determination theory (SDT), an organismic theory of human motivation, has been applied extensively to health-related behaviours such as physical activity (Banting, Dimmock, & Grove, 2011; Biddle, Soos, & Chatzisarantis, 1999; Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003; Longbottom, Grove, & Dimmock, 2012; Murcia, Rojas, & Coll, 2008), eating a healthy diet (Hagger, Chatzisarantis, & Harris, 2006b; Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004), and smoking cessation (Joseph, Grimshaw, Amjad, & Stanton, 2005; Williams et al., 2006); furthermore, it has wider applications to sport and exercise (Boiché & Sarrazin, 2007; Gillet, Vallerand, Amoura, & Baldes, 2010; Hagger & Chatzisarantis, 2007) and education or academic performance (Diaz-Greenberg, Thousand, Cardelle-Elawar, & Nevin, 2000; Liu, Wang, Tan, Koh, & Ee, 2009; Nie & Lau, 2009; Wijnia, Loyens, & Derous, 2011). In SDT, individuals are viewed as being innately predisposed toward growth,

mastery of challenges, and the integration with intrapersonal and interpersonal experiences to give a coherent sense of self (McLachlan, Chan, Keatley, & Hagger, 2012; Ryan & Deci, 2000a). The interaction between individuals and social agents in their environment determines the quality of motivation through the satisfaction of three fundamental psychological needs for autonomy, competence, and relatedness (Patrick, Knee, Canevello, & Lonsbary, 2007; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Ryan & Deci, 2000b). The extent to which these needs are satisfied determines behavioural performance and persistence.

When an individual's behaviour is self-determined or autonomous, they feel a sense of authorship or choice in performing behaviour; therefore they are likely to engage in an activity for the inherent interest, enjoyment, and satisfaction of performing the behaviour and are likely to persist with that behaviour without external incentive or contingency. Individuals' choice to continue an activity when no external pressure is often tested using free-choice paradigms (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Moller, Deci, & Ryan, 2006), see Chapters 4 and 6. Free-choice paradigms were adopted as behavioural persistence, taken as a measure of motivation, is measured as the time a person freely chooses to spend on an activity. Autonomy-oriented individuals will be more effective in self-regulating their behaviour without the need for social agents to maintain observation and reinforcements. In addition, the main outcome of being autonomously motivated is behavioural persistence in the absence of reinforcing contingencies. In contrast, individuals may perform behaviours for controlled or extrinsic motives and do so because of

pressures perceived to lie outside of the individuals, or for the attainment of external reinforcement (e.g., money or reward). The main outcome of controlled regulation of behaviour is the desistence of a behaviour in the absence of controlling contingencies. For successful behaviour change to occur the focus should be placed on supporting individuals' autonomy, and reducing the perception of pressure or external contingencies (Chatzisarantis & Hagger, 2009; Silva et al., 2008).

In self-determination theory a set of more nuanced and differentiated forms of motivation is typically made. Motivation is classified into several subtypes oriented about the autonomous and controlling constructs and is organised along a continuum of motivation known as *perceived locus of causality* (PLOC; Ryan & Connell, 1989). The PLOC outlines how the degree of internalisation and integration of behaviours with personally held values also reflects changes in the type of underlying motivation. Persistence increases for behaviours that are performed for more autonomous reasons, and the continuum charts how some behaviours can be 'taken in' or internalised such that perceptions about them change from being externally referenced and controlled to internally referenced and autonomous. *Intrinsic motivation* is situated at one extreme and is the "prototype of self-determined activities: they are activities that people do naturally and spontaneously when they feel free to follow their inner interests" (Deci & Ryan, 2000, p234; see also Deci, 1975). Intrinsic motivation leads to individuals feeling behaviour originates with and emanates entirely from the self. Intrinsic motivation has been defined in the literature as activities that "individuals find interesting and would do in the

absence of operationally separable consequences" (Deci & Ryan, 2000, p233). Externally-referenced behaviours may be adopted and endorsed so that they become part of a person's repertoire of behaviours that satisfy psychological needs

Within the externally regulated subtypes, *integrated regulation* is situated adjacent to intrinsic motivation and is the most internalised of the external regulation subtypes. Integrated regulation relates to behaviours that are fully integrated into the repertoire of behaviours that satisfy an individual's psychological needs and appears to emanate from the individual. *Identified regulation* comes next to integrated regulation and outlines behaviours arising from recognition of valued outcomes of the behaviour. Individuals' engage in a particular behaviour in order to attain outcomes that are deemed personally important. *Introjected regulation* is a less autonomous form of motivation than identified regulation, and is characterised as performing behaviours in order to attain desirable internal states (e.g., self-esteem), and avoid aversive internal states (e.g., shame, guilt). Individuals with introjected regulation will put a lot of pressure on themselves to perform well at a task in order to move closer to the desired internal states, and away from the negative internal states. This motivation is therefore partially internalised, and the regulation is not consistent with the individual's integrated set of values and aspirations that from their self-concept. Finally, *external regulation* is the most controlled form of motivation and lies at the opposite extreme pole of the continuum, relative to intrinsic motivation. External regulation is the prototypical form of extrinsic or controlled motivation, reflecting behaviours performed solely for external

reinforcement (e.g., money, rewards). Typically, when the external reinforcement ceases, performance diminishes and often ceases altogether.

A further premise of SDT is that people exhibit individual differences in dispositional motivational orientations. Some individuals experience a high degree of choice when initiating a behaviour (autonomy-orientation); others tend to experience their behaviour as controlling or pressured (control orientation). Differences in these relatively enduring motivational orientations are outlined in General Causality Orientations theory (GCOS; Deci & Ryan, 1985). These differences in orientations illustrate a generalized tendency to interpret situations as autonomy-supportive (e.g., allowing them a sense of choice or authorship over the behaviour) or controlling across a range of behavioural contexts. An autonomy orientation has been defined as "the tendency to regulate behaviour on the basis of integrated goals and values, and involves a sense of choicefulness about and endorsement of one's own behaviour (Levesque & Pelletier, 2003, p352). Furthermore, motivational orientations may moderate the effect of external contingences and environmental factors on individuals' motivation and subsequent behavioural engagement. For example, individuals with an autonomous orientation will be more likely to interpret behaviours as internally referenced and emanating from the self (i.e., autonomous) and thus persist for longer, even if the behaviour is associated with an environmental contingency that would typically undermine autonomy such as a reward (Hagger & Chatzisarantis, 2011). Furthermore, in relation to the focus of the present thesis, it has been suggested that "the needs for autonomy... provided a useful way of

interpreting a large number of experimental findings concerning how people's spontaneous interest in an activity can be forestalled versus promoted" (Deci & Vansteenkiste, 2004, p27-28). Essentially, an autonomous orientation is likely to lead to individuals feeling authorship over their actions and a sense of self-determined free-will to start an activity, which is conducive to their need satisfaction and enjoyment. This, spontaneous process is arguably what an implicit measure of motivation should assess.

Although causality orientations are a distal, global influence on multiple behaviours and contexts, more proximal motivational factors, such as PLOC constructs, are likely to have a greater influence on behaviour in specific contexts. Given the distal nature of causality orientations, it may be that they affect behaviour outside of conscious awareness, given that these individual differences serve to guide behaviour because they tend not to be involved in the conscious, decision-making process. For this reason, implicitly-measured motivational orientations predicated on associations between 'self' concepts' and motivation orientations (autonomous or controlled), such as the IAT, should be well-positioned to provide valid measurement of these underlying dispositional motivational orientations and permit testing of models that incorporate such motives alongside more traditional explicit measures (Kehr, 2004; Strack & Deutsch, 2004).

Generalized causality orientations may also provide the basis for understanding the role of implicit, non-conscious processes in research on motivation. Autonomy-oriented individuals are likely to exhibit a quicker

propensity for associating stimuli related to autonomous or intrinsic motivation (e.g., words related to autonomous motivation: 'value', 'enjoy') with personal attributes (e.g., words relating to the self: 'I', 'me'). Control-oriented individuals, in contrast, should exhibit quicker response times for 'self' and extrinsic stimuli (e.g., words related to controlling motivation: 'should', 'forced'). Implicit measures are well-positioned to assess these associations, as they are posited to be outside of conscious awareness (Bargh & Ferguson, 2000). Self-determination theory, therefore, outlines differences in behavioural outcomes between autonomous and controlled motivation, and provides an explanatory framework as to how individuals' motivation orientation may relate to implicit measurement of their motivation.

Implicit Measures of Motivation

Defining implicit constructs

Research on implicit social cognition and associated branches such as implicit motivation include various terms and synonyms, which can sometimes make precision and clarification diminish. Within the area words that are typically used include: *automatic, implicit* or *unconscious* processing, and *controlled, explicit* or *conscious* processing. Due to the use of multiple, related terms, readers can often be left with only a vague sense of understanding over what exactly is being researched (Payne & Gawronski, 2010), especially when considering terms from SDT. While the overall debate on terminology continues, for the purpose of the research presented in the current thesis, the term *implicit* will be used most frequently and therefore

requires clarification. Some researchers have used the term to describe characteristics of measurement procedures that provide assessment of individuals' psychological attributes (e.g., attitudes or motivation) without the need to ask individuals directly, explicitly for the information (Fazio & Olson, 2003). Other researchers have used the term to describe the psychological constructs or systems that are assessed by a particular type of measure that does not require explicit conscious introspection (Banaji, 2001).

While the choice of term itself is largely nominal, a distinction should be offered to facilitate understanding. De Houwer and colleagues (2009) suggested a distinction in terms between those referring to measurement procedures, and those referring to psychological attributes. Based on the two ways the term *implicit* has previously been used, a similar approach will be adopted in the current thesis; however, the current thesis will substitute different words to those previously suggested by De Houwer. Instead of *direct* and *indirect* as terms referring to features of measurement procedures, *implicit* and *explicit* will primarily be used when referring to measures of motivation. Given the IAT is used in most of the studies herein, maintaining a consistency in terms for the name and features of the measure reduces semantic confusion. With regards the use of *implicit* in this thesis, it may be defined as processes that are non-conscious, unintended, or beyond conscious control. As Strack and Deutsch's (2004) dual-systems model is chosen to provide a conceptual understanding of studies presented in the current thesis, their terms *reflective* and *impulsive* will be used when describing psychological attributes that are assessed by different measurement procedures.

Implicit measurement

The Implicit Association Test (IAT)

The implicit association test (IAT; Greenwald et al., 1998) is used in the majority of studies in the current thesis. The IAT was originally developed and used as a measure of individuals' attitudes towards such areas as prejudice (Bohner, Siebler, Gonzalez, Haye, & Schmidt, 2008; McConnell & Leibold, 2001), and consumerism (Friese, Wanke, & Plessner, 2006; Maison et al., 2004; Wanke, Plessner, Gartner, & Friese, 2002), for example.

More recently, the IAT has been developed to offer implicit measurement of individuals' self-concept, or implicit identity (Asendorpf, Banse, & Mücke, 2002; Back et al., 2009; Perugini & Leone, 2009). The IAT assesses the strength of underlying associations between target categories (e.g., self vs. other) and attribute categories (e.g., autonomous vs. controlled), which are arranged on bipolar dimensions. The strength of association is operationalized as participants' response latency for categorising stimuli that represent the four categories (e.g., words typical for self vs. others, autonomous vs. controlled) through the use of two response keys, each assigned to a target-category pairing. The basic premise of the IAT is that when highly associated target and attribute pairings share the same key, response latencies should be quicker than incompatible target-attribute pairings.

Table 1. Example Task Sequence of an Implicit Association Test for Individual's Self-concept of Motivation

		Response Key Pairings	
Block	*N* trials	Left Key	Right Key
1	20	Self	Others
2	20	Autonomous	Controlled
3	20 + 40	Self, Autonomous	Others, Controlled
4	20	Controlled	Autonomous
5	20 + 40	Self, Controlled	Others, Autonomous

Note. Blocks 1, 2 and 4 are practice blocks and are not entered into the final analyses. Blocks 3 and 5 contain 20 practice trials and 40 critical or test trials; all 60 are entered into the final analyses to compute the IAT D-score. Ordering is also counterbalanced so that half the participants also make 'self-controlled' pairings first.

Table 1 outlines the structure used for the IAT in the current thesis. The practice blocks are used to acquaint participants with the general procedure of the measure and minimise errors made during the test blocks (3 and 5). For the current example, participants would press the left key for stimuli related to 'self' or 'autonomous' and right key for stimuli related to 'others' or 'controlled'. The implicit measures in the current thesis represented either extreme of the motivation continuum, from intrinsic motivation at one end, to extrinsic motivation at the other end. The words used represent key attributes of what it is to be intrinsically motivated (i.e., freely able to spontaneously perform any behaviour, and have authenticity or ownership over that behaviour); through to a controlled or forced form of motivation. As autonomy is essential to intrinsic motivation (Deci & Casico, 1972; Deci & Ryan, 2000), the use of words which represent both the need for autonomy and the experience of intrinsic motivation are acceptable. At the time of study, no other measure of implicit motivation existed; however, it may be possible to use

alternative words strictly related to either autonomy (e.g., ownership, authenticity), or intrinsic motivation (e.g., enjoyment, value). This was beyond the scope and not an aim of the present studies. It should be noted that for all implicit measures in the current thesis, 'others' was explained and defined as being words that did not relate to the self. This label has been used in previous research (Brunstein & Schmitt, 2004; Levesque & Brown, 2007), and after pilot testing, the majority of participants found it easier to discriminate as a label than 'not self'.

The difference in response latencies between blocks 3 and 5 (the critical blocks) is termed the IAT effect. The size and direction of the IAT effect is interpreted as showing the relative association strength between target and attribute categories. Therefore, individuals with an implicit orientation for autonomous motivation will show faster response times for block 3 than block 5. The coding throughout the studies presented here is such that a positive score or IAT effect is indicative of a more autonomous orientation.

The improved scoring algorithm (Greenwald et al., 2003), which provides a *D*-score for the IAT effect, was proposed to overcome several noted limitations of the IAT such as task switching (Mierke & Klauer, 2001, 2003). The improved algorithm has a number of steps needed to calculate the final *D*-score. The main differences between the conventional algorithm and the improved algorithm are the elimination of trials > 10,000 ms, and elimination of participants with more than 10% of trials having a latency less than 300 ms. Furthermore, means for the correct latencies in blocks 3 and 5 are then

calculated. For trials in which a wrong response was made, the latency for that trial is replaced with block mean + 600 ms. Averages are then calculated for blocks 3 and 5 for the correct responses and error latency responses. Differences are then calculated between blocks 3 and 5 (computed in the opposite direction depending on which pairing was presented first). Differences are divided by the *SD* of the pooled-trials.

Though *D* scores are widely used and reported now, there remains continuing debate over the suitability of the criteria over which the *D* score has been developed (Teige-Mocigemba, Klauer, & Sherman, 2010; Wentura & Rothermund, 2007). A major criticism is that *D* scores have been chosen by maximising the correlation between IAT results and correlations with explicit measures. The lack of correlation between implicit and explicit measures has been counted as a limitation of implicit measures for some time (Hofmann, Gawronski, Gschwendner, Le, & Scmitt, 2005); however, maximising this correlation may diminish the implicit nature of the IAT. At present, the improved algorithm is the most widely used and supported means of analysing IAT scores, and is therefore used for all implicit measures in the current thesis.

The Go/No-go Association Task (GNAT)

A limitation of the IAT is that it provides only a relative measure of implicit autonomous and controlled motivation. Therefore, individuals' implicit autonomy and controlled scores cannot be taken separately. To overcome this issue, several single-category implicit measures have been developed, such as the single-category implicit association test (SC-IAT; Karpinski & Steinman, 2006) and go/no-go association task (GNAT; Nosek &

Banaji, 2001). The GNAT developed for the current research uses a go/no-go task in which participants were asked to respond with a "go" response (e.g., press a key) when a stimulus appears that is a member of the target attribute pair (e.g., self + autonomous), and a "no-go" response (i.e., no key press) when the stimuli is a member of the opposed category (e.g., other). The 5 step block progression of the GNAT is similar to that of the IAT, in terms of pairings. Due to the structure of the GNAT developed for the present research, it was possible to use a *D* score measure, which has been done previously (Boldero, Rawlings, & Haslam, 2007; Teachman, 2006).

Psychometric properties of implicit measures: Threats to the reliability and validity of implicit measures

The psychometric properties of implicit measures have been a point of contention in the literature. The original argument for implicit measures was that they would provide a true insight into individuals' hidden or concealed attitudes. A further postulate was that implicit measures, such as the IAT, would not be susceptible to demand characteristics or self-serving biases (Greenwald et al., 1998). To this extent, implicit measures became an attractive addition to research focusing on topics that entailed awareness of self-presentation (e.g., studies focusing on racism). Testing the validity of implicit measures can happen at the group-level, or individual-level.

An example of group-level tests of validity is the *known-group* approach. The known-group approach contrasts groups that are assumed to differ with regards their attitude to the construct of interest, and research has supported the claim that the IAT does provide valid measurement of attitudes.

For example, black and white individuals differed in their racial attitudes (Nosek, Banaji, & Greenwald, 2002), and a IAT for attitudes towards homosexuality successfully distinguished between homosexuals and heterosexuals (Banse, Seise, & Zerbes, 2001). In behavioural terms, IATs have been used to successfully distinguish smokers from non-smokers (Swanson, Rudman, & Greenwald, 2001). Therefore, there is reason to believe that the IAT in the present series of studies could distinguish autonomously-motivated individuals from individuals with controlled motivation orientations. However, as the strength of the known-group approach relies on how categorically the groups can be differentiated on a priori grounds, the application of this approach to motivational orientations from SDT is unclear. Individuals may have both autonomous and controlled motivation orientations for different behaviours or contexts, so it remains uncertain whether implicit measures can successfully distinguish between individuals with these motivational orientations.

Due to limitations with using group-level tests of validity, individual-level tests maybe more appropriate for the current research. Individual-level tests of validity include the IATs correlation with other established measures (i.e., explicit measures), and the predictive validity of behavioural measures. IAT measures typically exhibit low correlations with explicit measures of the same construct. A meta-analysis including various content domains (including attitudes and self-concept) showed a low correlation of .24 between IATs and explicit measures. While this may give rise to some concern over the validity of the IAT measures in general (either attitudinal or self-related), there is still

debate over whether these low correlations should be interpreted as convergent or discriminant validity (Nosek & Smyth, 2007; Payne, Burkley, & Stokes, 2008). If the cognitive structures underlying implicit and explicit measures are independent, then implicit-explicit correlations may be interpreted as indices of discriminant validity. However, if the implicit and explicit measures are tapping the same representation, then the correlations should be seen as convergent validity. At present, there is no resolution to this debate. It is important to note, however, that implicit-explicit correlations are typically low throughout the literature.

The greatest support for the use of implicit measures in research has come from studies using IATs to predict behaviour independently and sometimes better than explicit measures (Conner, Perugini, O'Gorman, Ayres, & Prestwich, 2007; Perugini, 2005). A recent meta-analysis showed evidence for the predictive validity if IATs in general across a large number of behaviours (Greenwald, Poehlman, Uhlmann, & Banaji, 2009). However, there is some inconsistency over which domains the IAT provides better prediction of behaviour than explicit measures. The IAT provides more consistent predictive validity in research involving attitudes related to socially sensitive topics, such as prejudice. For health-related behaviours, the predictive validity of the attitudinal and self-related IATs may be reduced (Karpinski & Hilton, 2001). However, these findings relate to attitudes, rather than motivation – an issue that is addressed in the studies presented in the current thesis. The majority of research into health-related behaviours has focused on attitudes towards different foods and the relation of the measure to eating habits

(Craeynest et al., 2005; Friese et al., 2006; Hofmann & Friese, 2008). It is less clear whether motivation toward other health-related behaviours would follow the same trends. This is the primary focus of the first two chapters of the current thesis. The aim of these chapters is to assess the predictive validity of implicit measures (IAT and GNAT) towards health-related behaviours.

Integrating self-determination theory and implicit measures

Research into goal-directed, motivated behaviour has traditionally adopted an explicit approach. Motivational antecedents of behaviour are typically assessed with self-reported measures, forming a wide range of explicitly-based theories and models (Ajzen, 1991, 2002; Fishbein & Ajzen, 2009; Hagger & Chatzisarantis, 2009). More recently, research has begun to focus on the unique effects of implicit or impulsive processes on behaviour. Although the majority of this research initially focused on how implicit attitudes may affect behaviour (Craeynest et al., 2005; Czopp et al., 2004; Maison et al., 2004; Sherman, Chassin, Presson, Seo, & Macy, 2009), as understanding of implicit processes increased and measures were developed, the research also incorporated implicit self-concept and motivation for goal-directed behaviour (Brunstein & Schmitt, 2004; Schultheiss & Brunstein, 1999).

A small number of studies have now examined the role of implicit motives as an influence on behaviour and behavioural outcomes in the context of SDT (Burton et al., 2006; Levesque & Brown, 2007). As outlined, individuals' motivational orientations may be assessed through the differences

in reaction times for target-attribute associations. Burton et al. (2006) studied the effect of implicit autonomous forms of motivation, measured using a lexical decision task (LDT), on students' well-being and exam performance. Results supported the significant contribution of implicit forms of autonomous motivation in the prediction of academic performance, providing preliminary support for the predictive validity of implicit measures of motivation from self-determination theory. The study conducted by Burton and colleagues provided a strong case for further research to be conducted, especially with regards the implicit measure used. While the LDT shares the same underlying principles as the IAT, in terms of reaction times to category-target pairs, it does not have as extensive support in the wider literature. Future research has therefore generally incorporated more widely-used implicit measures, such as the IAT and GNAT. A further limitation of Burton and colleagues' research was that the contributions of implicit and explicit measures of motivation from SDT were not investigated in the context of dual-route systems of behaviour.

Further research into the relationship between implicit processes and motivation was conducted by Levesque and Brown (2007). In their study, an IAT was developed to measure implicit motivation from SDT. The IAT developed by Levesque and Brown provided the basis for the measure used in the studies reported in the current thesis. In their research, Levesque and Brown investigated the relationship between implicit and explicit measures of motivation, as well as the possibility that mindfulness – a variable reflecting the degree to which an individual has an elevated level of attention and awareness, moderated the relationship. Results indicated that for those

participants with lower levels of mindfulness, an implicit autonomy orientation provided significant prediction of day-to-day behavioural motivation. Levesque and Brown's research therefore provides further support for the role of implicit motivation in the prediction of behaviour. However, Levesque and Brown did not integrate their research with dual-route models of behaviour that incorporate both impulsive and reflective systems as influencing behaviour, which may have further clarified the psychological processes underpinning their findings.

Self-determination theory and priming motivation

In addition to research focusing on the predictive validity of implicit measures of motivation from SDT, researchers have also investigated the role of priming motivation orientations on behaviour. Through measuring the extent that priming manipulations affect motivation, greater understanding is gained for the extent that behaviour occurs without conscious awareness. Research into priming motivation typically uses supraliminal (i.e., tasks participants are aware of conducting, without necessarily realising the priming process) procedures in which completion requires conscious deliberation and thought processes. However, although the priming task is supraliminal, researchers contend that it activates cognitive representations and associations at the impulsive level. These primed concepts then operate automatically and outside of conscious awareness to influence behaviour. Studies using supraliminal procedures typically show little to no awareness on post-manipulation checks (Levesque & Pelletier, 2003).

The effect of underlying motivational orientations on performance was first investigated by Levesque and Pelletier (2003). Through a series of studies, Levesque and Pelletier demonstrated that priming individuals' autonomous or controlled orientations led to outcomes similar to those who were dispositionally, or 'chronically', oriented toward autonomy or controlled motivation, as measured by explicit measures. This gives preliminary support for the theory that implicit motivational constructs from self-determination theory provide a unique effect on behaviour. Furthermore, as priming affected implicit, non-conscious autonomous and controlled motivational orientations and yielded similar behavioural effects as individuals with generalized, dispositional 'chronic' orientations, it implies that implicit measures may reflect more dispositional, generalized motivational orientations.

In addition to the previous research on priming manipulations and SDT, Hodgins, Yacko, and Gotlieb (2006) showed that priming motivation orientations affected participants' performance. Hodgins and colleagues administered autonomy and controlled motivation primes to participants and measured the changes in self-handicapping (the extent to which participants made excuses for their performance) and actual behaviour. Results indicated that autonomy-primed participants used significantly fewer anticipatory excuses and performed better than those who received the prime for controlled motivation. Though Hodgins and colleagues were more concerned about the effects of motivation orientation on defensiveness, their research supports the relationship between priming and performance.

Ratelle, Baldwin, and Vallerand (2005) extended the research into implicit processes and self-determination theory by showing cued activation of situational motivation. Self-determination theory postulates that motivation can generalise across activities because of contextual cues that activate a motivational state associated with prior experience (Vallerand, 1997; Vallerand & Ratelle, 2002). Several studies have supported the process of using classical conditioning procedures to associate an initially neutral cue (e.g., tone) with intrapersonal states (Baldwin, Granzberg, Pippus, & Pritchard, 2003; Baldwin & Main, 2001; Baldwin & Meunier, 1999). When the tone is replayed later it recreates the subjective internal state previously felt. Ratelle and colleagues extended this finding across two experiments to show that autonomous and controlled motivation could be cued. In the first experiment, a tone was paired with controlling feedback. Participants given a control-associated tone were significantly less likely, than those who received a neutral tone, to continue a task when given the choice to stop. In the second experiment, these findings were extended to include cued activation of autonomous motivation. Explicit self-report measures showed a significant difference in experienced motivation between the controlling and autonomy-supportive groups.

Dual-systems models

While research into motivation has typically adopted explicit measures and therefore assessed the effect of the reflective system in behavioural engagement, there is growing support for the role of the impulsive system in goal-directed behaviour. It is therefore important to understand whether the motivational constructs proposed in SDT operate in both the reflective and

impulsive systems, using a dual-systems model to better understand the role of each system in behavioural performance.

Several models of the direct and multiplicative patterns of reflective, deliberative and impulsive, automatic processes have been proposed (Bargh, 1990, 1997; Bargh & Chartrand, 1999; Fazio & Towles-Schwen, 1999; Strack & Deutsch, 2004; Wilson et al., 2000). These models share similar general assumptions that structurally different systems of information processing underpin automatic, impulsive forms of behaviour on the one hand, and more deliberative, reflective behaviours on the other. There is also evidence to suggest different brain areas and networks may underlie these systems (Lieberman, 2003; Satpute et al., 2005; Zarate & Stoever, 2003).

Smith and DeCoster (2000) showed the commonalities and distinctions between several prominent models, in a systematic comparison. The common feature of all models was the distinction between a rule-based system or route that required higher-order cognitive processes, and a system or route governed more by associative processing, and is characterised as being automatic or non-conscious. The main distinction between models was whether these two systems occur, or affect behaviour simultaneously or sequentially (Smith & DeCoster, 2000). While this issue has not been comprehensively resolved so far in the literature, it is worth noting that the majority of previous models have directed little attention to the behavioural outcomes of the mental processes and mechanisms; furthermore, and of critical importance to the current thesis, they do not incorporate findings from motivational science (Higgins & Kruglanski, 2000; Strack & Deustch, 2004).

The reflective-impulsive model (RIM; Strack & Deustch, 2004) provides an important contribution to the growing literature on dual-process models as it integrates motivational, behavioural, and cognitive elements into a two-system model of behaviour. The RIM accounts for the effect of individuals' motivational drive or orientation in the underlying processes that affect behaviour (Cacioppo, Priester, & Bernston, 1993; Gollwitzer, 1999). Given the focus of the current thesis on the role of impulsive and reflective processes on behavioural engagement and persistence, the RIM was deemed the most appropriate model. The RIM synergistically complements tenets of SDT in terms of focusing on the role of internal, intra-individual motivational processes and orientations, and the subsequent effects on behaviour. In addition, both the RIM and SDT also provide an account of the role of context or environment the individual is in. Therefore, RIM seemed to the most appropriate dual-systems model. A further reason for choosing the RIM was that it had already been applied to the explanation of health-behaviours and motivation (Friese, Hofmann, & Schmitt, 2008; Hofmann, Friese, & Wiers, 2008); therefore, there was already a basis on which to conduct further research.

Reflective and impulsive processes in the RIM are proposed to operate in parallel, instead of consecutively or sequentially. If the two systems do operate in parallel, this has implications for the pattern of prediction each system could have on behaviour. Perugini (2005) outlined a number of these patterns (outlined in later in this section). Within the current thesis, the RIM was included as a conceptual basis with which to understand the predictive validity of implicit and explicit measures of motivation. While several of the

patterns of prediction were directly tested in the studies conducted (e.g., the additive pattern, see Chapter 2; and multiplicative pattern, see Chapter 3), the main focus of the thesis is to what extent implicit measures of motivation from SDT increase predictive validity over explicit measures of motivation. However, as some of the patterns of prediction from the RIM have been tested, a discussion will also be made about the suitability of a dual-systems model in SDT, and to what extent the current research supports tenets of the RIM.

The reflective system encompasses those processes that are deliberative, planned, or consciously processed, based on consideration of available information and intended future states. This system serves regulatory goals and is responsible for higher-order mental operations. Given the relatively slow and elaborate process of deliberating over decisions or assembling strategic action plans, a lot of cognitive resource is required for the reflective system to function effectively. To this extent, if cognitive resources are depleted, that is to say if the person is tired or focused on other tasks, the reflective system may not operate optimally. In these circumstances, the impulsive system may become the primary influence on behaviour.

The impulsive system, in contrast to the reflective system, generates impulsive forms of behaviour. These impulses are presumed to arise from activation of associative networks, or perceptual input. Implicit measures, especially those predicated on associative networks, such as the IAT, may therefore provide valid measurement of the impulsive system. The model also highlights that input from the reflective system may affect the impulsive system. This supports the argument that supraliminal primes (completed

through reflective processing) may also activate the impulsive system. The association networks function on the basis of repeated spatial or temporal coactivation of external stimuli, internal reactions, and behavioural tendencies. Ratelle and colleagues' (2005) research, for example, can therefore be understood in terms of the RIM. The external stimuli (computer tone) and internal reaction (feelings of being controlled) lead to cessation of behaviour. Due to the nature of the impulsive system, associative networks can be quickly reactivated by perceptual input. As these networks require no conscious awareness or attentional resources in their development or functioning, they may operate entirely out of conscious awareness and exert influence without an individual's realisation. The implications of the impulsive system (i.e., performing an action) are independent of whether a person actually endorses the behaviour (Gawronski & Bodenhausen, 2006; Hofmann, Friese, & Strack, 2009).

Conceptually, therefore, the RIM provided the framework for the research in the current thesis. As outlined, a more comprehensive explanation for the effects of motivational processes in previous research may be gained by adopting a dual-system approach. Measuring both systems within the same study provides an opportunity to test a number of possible patterns between the reflective and impulsive systems. Perugini (2005) tested three possible models: *additive* – the two systems offer unique prediction of behaviour; *multiplicative* – the two systems interact to influence behaviour; and, *double-dissociation* – the implicit system influences spontaneous behaviour, whereas the explicit system influences more deliberative behaviours. Support for multiplicative and

double-dissociation patterns was provided in Perugini's study. The multiplicative model is compatible with dual-systems models in that the two systems interact to provide prediction of behaviour over and above their individual contributions. Perugini's findings offer support for the RIM model, and builds on previous models. Additional patterns were later added, such as moderation patterns (Perugini, Richetin, & Zogmaister, 2010).

An additional benefit of the RIM is the inclusion of motivational orientations. Essentially, the impulsive system may be oriented towards either approach or avoidance. Therefore, the basis for integrating more extensive theories, such as SDT, is supported within the RIM. The model also outlines that compatibility between the dominant motivation orientation and environmental or reflective input leads to facilitation of processes. In support of this possibility, Hofmann, Friese, and Strack (2009) suggested that the predictive validity of models may be enhanced if the models include not only reflective and impulsive precursors of behaviour, but also define situational and dispositional boundaries that may favour the effect of either system. Depending on these boundary conditions, behaviour may be better predicted by reflective or impulsive precursors. For example, Levesque and Pelletier's (2003) research showed chronic motivation orientation was a boundary condition for the effects of priming motivation orientations. For the effects of the reflective and impulsive systems to be fairly judged, therefore, boundary conditions should be taken into account when evaluating the predictive validity of related measures.

Overview of the present thesis

The aim of the series of studies reported in the present thesis was to research the role of implicit processes in motivation from self-determination theory. Few studies have integrated the relatively recent inception of implicit measures with self-determination theory. The present series of studies therefore aimed to provide a much-needed addition to the literature. Furthermore, the studies aimed to provide a unique contribution in terms of assessing the suitability of a dual-systems model (RIM; Strack & Deutsch, 2004) to explain the effects of implicit and explicit measures of motivation.

Across several studies, the predictive validity of implicit measures of motivation was assessed. To begin, it was important to develop a reliable, valid implicit measure of motivation. To this extent, the first two main studies focused on predictive a series of health-related behaviours using either a GNAT (Chapter 2), or an IAT (Chapter 3). Following on from this, two further studies were conducted (Chapter 4) to assess the predictive validity of implicitly-measured motivation on more objectively measureable tasks. Following from this research, students' motivation toward academic achievement was assessed (Chapter 5). At the beginning of the school year, students' implicit and explicit motivation towards academic work was measured. At the end of the academic year, grades were taken as the behavioural measure, and the extent to which implicit and explicit motivation predicted them was tested.

The focus of the research presented in the final study (Chapter 6) was to investigate whether completion of an implicit measure of motivation would

affect subsequent manipulation (through priming) and behaviour overall. This final study provides an important contribution to the literature and future research by examining whether our measurement of motivation at an implicit level affects individuals' behaviour in further tasks or testing. This *mere measurement* effect (Conner et al., 2011; Godin et al., 2010) has been documented when individuals complete explicit questionnaires; however, the current research is the first to investigate whether this effect also occurs as a result of implicit measurement.

Chapter 2

Assessing the Predictive Validity of Implicit and Explicit Measures of Autonomous Motivation Across Health-Related behaviours

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Chapter 2: Assessing the Predictive Validity of Implicit and Explicit Measures of Autonomous Motivation Across Health-Related behaviours

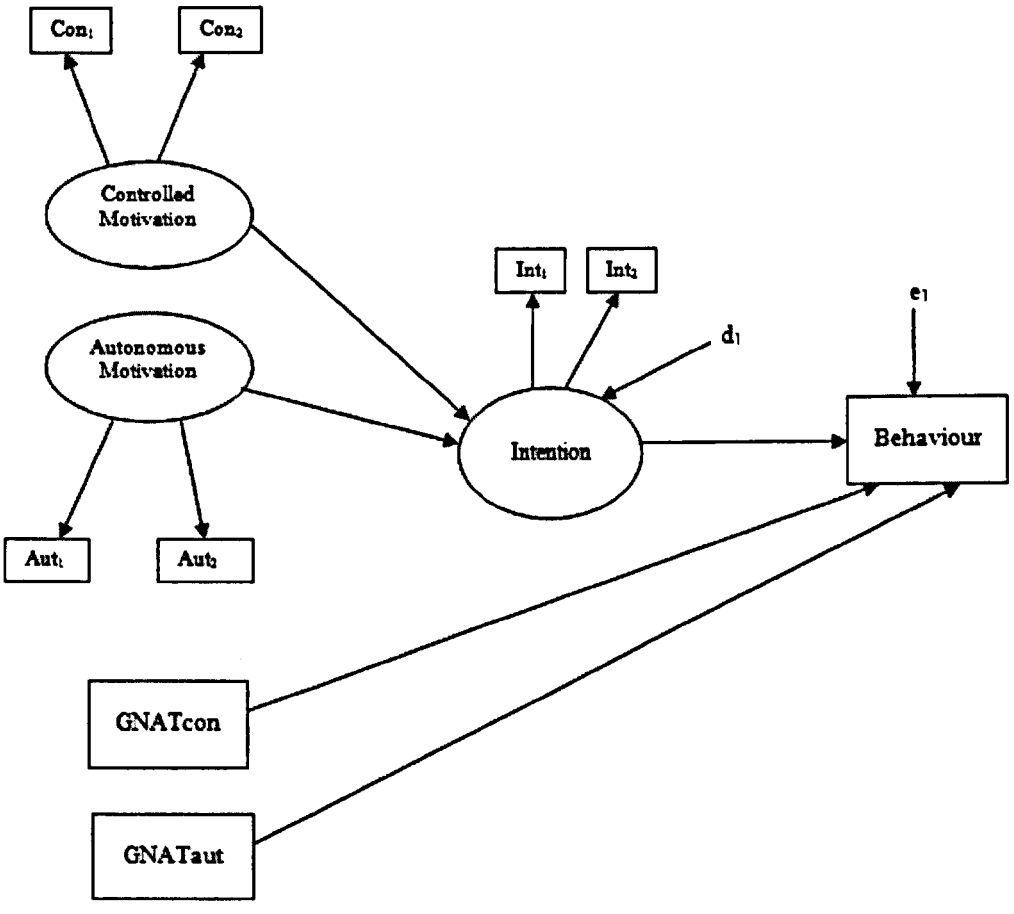
Introduction

In recognition of the dearth of research investigating the predictive validity of implicit measures of motivation from self-determination theory (SDT) and consistent with aims of the current thesis, this initial study investigated the predictive validity of a novel measure of implicit motivation from SDT across a range of health-related behaviours. The aim of the present study was to extend the literature focusing on implicit processes in SDT. Previous research has outlined the role of implicit processes in day-to-day behaviours (Levesque & Brown, 2007); the present research, focused on the effect of implicitly measured motivation for performing health-related behaviours over a four-week period. This provided a more stringent test of implicit measures of motivation from SDT. A go/no-go association task (GNAT) was used in this study in order to assess the efficacy of measuring implicit autonomous and controlled motivation independently. While previous research used a relative measure of implicit motivation (the IAT), which prohibits dichotomisation of autonomous and controlled forms of motivation. Deci and Ryan (2000) proposed that individuals can hold both forms of motivation, therefore the ability to measure them independently may provide more valid prediction of behaviour.

The health behaviours measured in the current study were selected based on two main criteria. First, recent literature on motivation, intention, and health behaviours provided an initial preliminary list of researched health behaviours; following on from this, a group of students (N=20) were asked to list as many health behaviours pertinent to their daily lives as they could think of. From this preliminary testing, the top 20 health behaviours (defined as those mentioned most, or most prevalent in the literature) were taken and used in the study.

A dual-systems model was developed (see Figure 1), consistent with existing models in the literature (e.g., Strack & Deustch, 2004). From this a number of hypotheses were derived. On the lower far left of the model, the GNAT measures represent implicit autonomous and controlled forms of motivation. These measures were anticipated (H_1) to provide direct, independent prediction of behaviour. This was based primarily on previous research in which implicit measures have provided prediction separate from explicit measures (Czopp et al., 2004). Furthermore, dual-systems models posit that in certain circumstances, and for certain behaviours, the impulsive system provides direct prediction (e.g., for behaviours that are more spontaneous, or when cognitive load is high).

Figure 1. Hypothesized structural equation model for the predictive effects of implicit and explicit measures on behaviour



Note. Int = observed intention items indicating the latent intention measure; Con = explicit items indicating the latent controlled motivation measure; Aut = explicit items indicating the latent autonomous motivation measure; d = disturbance – reflecting error in prediction for a latent variable. e = error in prediction – predicts error in prediction for a non-latent variable; GNATaut = the autonomy GNAT measure; GNATcon = the control GNAT measure. GNAT measures were also calculated using the *D*-score. Covariances between implicit and explicit measures are not represented for reasons of clarity. Implicit and explicit measures of motivation were allowed to covary.

On the upper far left, the composite items of explicit autonomous and explicit controlled motivation are positioned. These measures were hypothesized (H_2) to predict intention, which will in turn act as a mediator (H_3) of the relationship between explicit measures and behaviour. These hypotheses were based on the RIM model, which posits intending as a final process in the reflective system. Furthermore, complementary theories such as the theory of planned behaviour (Chatzisarantis, Hagger, Smith, & Sage, 2006; Orbell & Hagger, 2006) also include intention as a mediator of the link between explicit future expectations regarding future behaviour and actual behaviour, while suggesting explicit measures do not provide a direct prediction of behaviour. Therefore, it was anticipated that explicit autonomous and controlled motives would not directly predict behaviour (H_4). Finally, the model presents intention as being the most proximal influence on behaviour. Therefore, intention was proposed (H_5) as a direct predictor of behaviour based on theories, such as the RIM and the theory of planned behaviour.

Method

Participants

Undergraduate students (N = 162; 101 female, 61 male, M_{age} = 22.12, range: 18-44 years) from the University of Nottingham volunteered to participate in the current study. Twelve participants failed to complete the follow-up questionnaire due to absence or failure to contact, leaving 150 participants' data available for analysis. Students were contacted via email with details of the study and the opportunity to participate. There was a £4 inconvenience allowance allocated for participation. The study protocol was approved by the School of Psychology Ethics Committee at the University.

Measures[1]

GNAT. Two go/no-go association tasks were used to gain separate implicit measurement of autonomous and controlled motivation. The GNAT is derived from the IAT and is based on the same underlying principles as other response-competition implicit tasks in that stronger associations will facilitate categorization performance. Participants were first presented with instructions concerning the task. In one part of the test, participants responded when words presented belonged to either label 'self' or 'intrinsic[2]' (or extrinsic, depending on which version they were completing), and in another part of the task, participants responded to the labels 'others' and 'intrinsic' (or extrinsic). Given the two versions of the GNAT used, these are termed $GNAT_{aut}$ for the implicit measure of self and autonomous motivation, and $GNAT_{con}$ for the implicit measure of self and controlled motivation. Words representing autonomous forms of motivation (choice, free, spontaneous, willing, authentic) and controlled forms of motivation (pressured, restricted, forced, should, controlled) motivation and words relating to 'Self' (I, me, my, mine, self) and 'Others' (others, they, them, their, theirs) were taken from research conducted by Levesque and Brown (2007), in which they were shown to offer a distinct representation of the two motivational orientations. Responses were made within a short response-time window (700ms), which was within the range suggested by Nosek and Banaji (2001). A 250ms inter-stimulus interval separated trials, during which participants received feedback regarding the

[1] Example questionnaires for studies presented in Chapter 2 and 3 are in Appendix 1.

[2] It was however made clear to participants exactly what was meant by the terms 'intrinsic' and 'extrinsic' and this was used to represent the autonomous-controlled distinction for participants because it was more intuitive means of representing the distinction between the two broad terms of motivation from the theory.

previous trial: either a green star for correct, or a red 'X' for incorrect. The GNAT consisted of two main blocks, each split into 20 practice trials, followed by 80 test/critical trials. During the critical blocks, participants saw two labels; participants were instructed to press the space bar ('go' response) if the presented word stimuli matched either or the labels, or inhibit a response ('no-go') if not. Stimuli from the target, category or distracter lists appeared randomly. Given the interest in target responses over distracter, there were twice as many target trials compared to distracter trials - to increase reliability, as only target trials were used for analyses. Results from both GNAT measures were calculated using the *D*-score (see Boldero et al., 2007; Teachman, 2006).

Perceived locus of causality. Explicit autonomous and controlled motivation from self-determination theory was measured through an adapted version of Ryan and Connell's (1989) perceived locus of causality (PLOC) scale, during the first wave of data collection. Participants were given a common stem for each behaviour (e.g., "I control calorie intake to control weight because..." or "I exercise regularly (3-4 times a week) because..."). Participants were then asked a series of reasons, relating to the various forms of motivation from self-determination theory (e.g., autonomous: "I enjoy controlling my calorie intake to control weight"; controlled: "I will feel guilty if I do not control my calorie intake to control my weight"). These were measured on a 4-point Likert-type scale ranging from *not true at all* (1) to *very true* (4).

The PLOC scales were then converted into weighted composite items representing separate autonomous and controlled indices (e.g., Guay, Mageau, & Vallerand, 2003; Hagger, Chatzisarantis, & Harris, 2006a). Autonomous items were calculated as the sum of a randomly-selected intrinsic motivation item weighted by a factor of two and a randomly-selected identified regulation item. This was repeated for the remaining intrinsic and identified regulation items resulting in three items representing explicit autonomous motivation. Controlled items were calculated as the sum of a randomly-selected extrinsic motivation item, weighted by a factor of two, and a randomly-selected introjected regulation item. This was repeated for the remaining extrinsic motivation and introjected regulation items to produce three items representing explicit autonomous motivation.

Intention. Intention to participate in behaviours was measured from responses to two items (e.g., "I intend to use stairs instead of a lift or escalator in the next 4 weeks" and "I plan to wash my hands after going to the toilet in the next 4 weeks"). Responses were given on 7-point Likert-type scales from *unlikely* (1), to *very likely* (7). Scores were then used as latent variables for each of the behaviours.

Follow-up. After 4 weeks, participants self-reported their performance for each of the 20 behaviours (e.g., 'In the past 4 weeks, how often have you eaten at least 5 portions of fruit and vegetables?') using 7-point Likert-type scales from *never* (1) to *Almost every day* (7). The criterion and concurrent

validity of this measure has been verified against objective measures (Hagger et al., 2006a).

Procedure

All participants were tested in isolation in a sound-proofed experimental cubicle. After sufficient information was given, and informed consent gained, they were asked to follow study instructions presented on a 14" computer screen. Participants completed GNATs administered using E-Prime software after completing 20 standard practice trials. The GNAT stage of the study lasted approximately five minutes. Order of GNAT completion was counterbalanced. After completion of the implicit measures, participants were asked to complete the explicit measures which typically lasted 20 minutes. Trials were fully counterbalanced so that half the participants conducted either implicit measure first, whilst the other half conducted the explicit measures first. There was no significant difference in scores between those who completed either GNAT first. Contact details were taken to expedite the collection of follow-up data four weeks later. Participants were contacted via email or telephone, depending on personal preference, so they could provide their self-reported participation in the 20 target behaviours. After completion of the follow-up measure, a full debrief of the study was offered and any further questions answered to the satisfaction of all participants.

Data analyses

Data were analyzed using structural equation modeling (SEM) using the EQS program (Version 6.1; Bentler, 2004). The proposed model was

estimated separately for each of the 20 behaviours. Goodness-of-fit of the estimated models was assessed through multiple criteria: the comparative fit index (CFI), the nonnormed fit index (NNFI), and the root mean square error of approximation (RMSEA). These fit indices were used because they display restricted random variation under model misspecification and a small sample size (Fan, Thompson, & Wang, 1999). Values approaching .95 for the CFI and NNFI, and 0.5 for the RMSEA are indicative of an adequate fit between model and covariance matrix (Hu & Bentler, 1999). A bootstrap resampling analysis was also conducted for each model to further check that models were not adversely affected by artifacts such as sample size and nonnormality, and ensure model robustness. In these analyses, data sets for each behaviour were taken as the "population", and samples were drawn randomly from this. The bootstrap procedure was replicated 999 times for each behaviour.

Results

No data were removed due to failing to meet improved scoring algorithm criteria (Greenwald et al., 2003). Overall, the fit statistics of the models across all behaviours met the multiple criteria for adequately-fitting models (median SB-χ^2 = 21.58, median $p > .05$; median CFI = .99; median NNFI = .97; median RMSEA = .06). The maximum likelihood estimation was used based on a matrix of variances and covariances.

Structural Equation Models

Figure 1 presents the general structural model for each of the behaviours and coefficients for behaviours are presented in Table 1[3]. Results indicated that implicit measures of autonomous and controlled motivation typically exhibited non-significant effects on behaviour (overall median beta for all behaviours $GNAT_{aut}$ = .04; $GNAT_{con}$ = -.03). However, the implicit measure of autonomous motivation significantly predicted tooth brushing (β = -.21, p < .05) and posture (β = .15, p < .05) behaviours. The implicit measure of controlled motivation significantly predicted alcohol consumption (β = -.20, p < .01)[4], and reduction in caffeine consumption (β = -.15, p < .05). These effects of implicit measures were direct and independent of intentions. However, as few behaviours were significantly predicted by implicit measures, this provided limited support for the hypothesis (H_1). The effect of explicit measures of autonomy on intention was significant for 15 behaviours (median β = .62), while controlled indices provided significant prediction for 10 behaviours (median β = .31), demonstrating a pervasive effect for the explicitly-measured forms of motivation on intentions to perform the behaviour in future, providing substantive support for this hypothesis (H_2) for the majority of the behaviours. Intention mediated the path from explicit

[3] Descriptive statistics and Correlation matrices between all factors for all behaviours are omitted in the interests of conserving space. They are available in Appendix 2.

[4] The direction (positive or negative) of the beta depends on the valence of the behavioural measure and the psychological measure. In this example, motivation to drink within limits should be negatively related to alcohol consumption; whereas if the motivational measure referred to motivation to drink ad libidum then it should have been positively correlated

Table 2. Standardized Coefficients of the Paths between Implicit and Explicit Measures and Behavioural Outcome

Behaviour	Int →Beh	Cont →Beh	Auto →Beh	GNATaut →Beh	GNATcon →Beh	Cont →Int	Auto →Int	GNATaut →Int	GNATcon →Int	Cont →Int →Beh	Auto →Int →Beh	GNATaut → Int →Beh	GNATcon → Int →Beh	R^2_{INT}	R^2_{BEH}
Calories	.404**	.150	.227**	.026	-.054	.476**	.362**	.056	.117*	.193**	.146**	.023	.047	.542	.464
LowFat	.627**	.143	-.090	-.023	.036	.232	.505**	.024	.013	.145	.317**	.015	.008	.474	.430
Belt	.538**	-.178	.036	.126	-.087	.451**	.022	-.041	-.004	.242**	.012	-.022	-.002	.218	.251
Sleep	.036	-.254*	.169	.065	-.118	.145	.541**	.025	-.027	.005	.020	.001	-.001	.377	.069
Alcohol	.013	.161	.084	.037	-.202**	.040	.656**	-.132*	.021	.001	.008	-.002	.000	.481	.104
Condoms	.277**	.062	-.319**	-.019	.024	.522**	.131	.030	.047	.145	.036	.008	.013	.363	.109
HandsFood	.381**	-.014	.312**	.065	-.083	.368**	.330**	-.071	.199**	.140**	.126**	-.027	.076*	.404	.353
Walk	.254*	.054	.229	.019	-.022	.191*	.559**	-.002	.003	.048	.142*	-.001	.001	.392	.202
Teeth	.280*	-.181*	.039	-.211*	-.039	.006	.303**	-.117	.062	.002	.085*	-.033	.017	.096	.149
JunkFood	-.094	-.049	-.390**	.052	-.008	.263**	.514**	.083	.102	-.025	-.048	-.008	-.010	.435	.221
Caffeine	-.142	.384**	-.609**	-.063	-.146*	.042	.768**	-.027	-.008	-.006	-.109	.004	.001	.640	.284
Stairs	.167	.005	.202	.047	-.025	.173*	.623**	-.130*	-.019	.029	.104	-.022	-.003	.461	.113
HandsToilet	.732**	-.145	.079	.033	-.076	.363**	.184	-.032	.124	.266*	.135	-.024	.091	.221	.496
Supplement	.699**	.126	-.056	.043	.065	.053	.839**	.033	.059	.037	.586**	.023	.042	.764	.551
Exercise	.517**	.045	.015	.027	-.024	.185**	.764**	.110*	.025	.096*	.395**	.057	.013	.709	.305
Planwork	.304**	-.102	.055	.030	-.070	.084	.454**	-.048	-.023	.025	.138**	-.015	-.007	.244	.108
Posture	.411**	-.321**	.208	.154*	-.102	.262**	.618**	-.117*	-.045	.108	.254	-.048	-.018	.634	.244
SodiumSalt	-.014	.121	-.533**	.061	.032	-.001	.812**	.049	.074	.000	-.011	-.001	-.001	.658	.226
Fiber	-.106	.070	.440*	.037	.057	.019	.812**	-.014	.065	-.002	-.086	.001	-.007	.675	.158
FruitVeg	.393*	-.095	.271	.095	.071	-.032	.840**	-.061	-.032	-.013	.330**	-.024	-.012	.679	.367

Note. Int = Behavioural intention; Cont = controlled measure (explicit); Auto = autonomous measure (explicit); GNATaut = autonomous GNAT; GNATcon = controlled GNAT; Calories = Reducing calorie intake; LowFat = eaten low-fat foods; Belt = wearing a seatbelt; Sleep = good night's sleep; Alcohol = drinking within daily limits; Condoms = using a condom; HandsFood = wash hands before preparing food; Walk = walking to take time-out or relax; Teeth = cleaning teeth; JunkFood = avoided junkfood; Caffeine = reducing caffeine/legal stimulant intake; Stairs = take stairs instead of lift/elevator; HandsToilet = wash hands after toilet; Supplement = using supplement to maintain healthy diet; Exercise = exercised regularly; PlanWork = plan work to avoid stress; Posture = sat with correct posture; SodiumSalt = avoid foods high in sodium/salt; Fiber = eaten sufficient dietary fiber; FruitVeg = eaten at least 5 portions.

* = $p < .05$, ** = $p < .01$

Table 3. Goodness-of-Fit Statistics for Structural Equation Models of Implicit and Explicit Predictors for Behaviours

	Goodness-of-fit statistics				Bootstrap Statistics			
Behaviour					CFI			
	SB-χ^2	CFI	NNFI	RMSEA	*M*	CI_{95}(LB)	CI_{95}(UB)	Skewness
Control calories to control weight gain	21.50	.990	.975	.054	.97	.94	.99	-.67
Eat low-fat foods	36.27**	.965	.916	.098	.94	.91	.97	-.41
Wear a seat belt in a taxi or car	15.47	.998	.995	.014	.94	.85	.100	-1.13
Get a good night's sleep	16.87	.991	.979	.029	.93	.85	.99	-1.26
Drink within alcohol limits	22.26	.986	.967	.057	.96	.92	.99	-.72
Wear condoms	9.93	1.000	1.00	.000	.98	.95	1.00	-1.97
Wash hands before handling food	11.87	1.000	1.017	.000	.97	.94	1.00	-.85
Go for walks to relax or unwind	22.66	.976	.942	.059	.93	.88	.98	-.56
Brushed your teeth	13.54	1.000	1.00	.000	.95	.87	1.00	-.99
Avoided eating junk food	19.99	.989	.973	.047	.96	.92	.99	-.51
Reduced consumption of caffeine	14.66	1.000	1.00	.000	.97	.94	1.00	-1.18
Walked stairs instead of using lift or elevator	34.26**	.956	.894	.093	.93	.87	.97	-.73
Washed hands after using toilet	22.33	.969	.926	.057	.92	.86	.97	-6.44
Taken supplements to maintain healthy diet	25.15*	.989	.974	.067	.97	.95	.99	-.70
Exercised regularly (3-4 times per week)	42.56*	.953	.888	.111	.94	.90	.97	-.54
Planned work in advance	21.66	.983	.959	.055	.95	.90	.99	-.65
Sat with the correct posture	16.35	.997	.993	.025	.97	.93	.99	-.59
Avoid foods high in sodium or salt	14.87	.1000	.100	.000	.98	.95	1.00	-.64
Eaten sufficient foods dietary fiber	36.58**	.950	.880	.098	.92	.87	.96	-.54
Eaten 5 portions of fruit or Vegetables per day	33.10**	.967	.921	.090	.94	.91	.98	-.21**

*Note. M*odel degrees of freedom = 15; CFI = comparative fit index; NNFI = non-normed fit index; RMSEA = root-mean squared error of approximation.

* = $p < .05$, ** = $p < .01$

measures of autonomous motivation to behaviour for five behaviours (median $\beta = .15$), and nine behaviours for the controlled path (median $\beta = .19$), so the hypothesis (H_3) was partially supported. Contrary to our hypothesis (H_4), the explicit controlled motivation measure significantly and directly predicted four behaviours (median $\beta = -.22$), and the explicit measure of autonomous motivation significantly predicted six behaviours (median $\beta = -.32$). Finally, as hypothesized (H_5), intention significantly predicted 13 behaviours (median $\beta = .40$). Intention therefore predicted the majority of the behaviours.

Bootstrap Procedure

The average CFI with 95% confidence intervals (CI_{95}) and skewness statistics for the bootstrapped models for each behaviour are given in Table 2. The 999 bootstrapped replications resulted in a successful fit of the specified model for all behaviours. The average CFI exceeded the cutoff criterion for analysis. In addition, the upper-bound CI_{95} for the CFI reached unity (median = .91), and the lower bound was above the minimum acceptable criterion of .90 (median = .99) for all behaviours. Furthermore, the distribution of the CFI was significantly and negatively skewed for the majority of behaviours (median = -.69), except fruit and vegetable consumption ($p < .05$). This is desirable in bootstrap analysis as it indicates a large number of well-fitting models in replicated samples. Overall, the bootstrap procedure provided support for the robustness of the hypothesized model.

Discussion

The aim of the current research was to assess the suitability of a dual-systems model (see Strack & Deutsch, 2004) as a framework for investigating the effects of implicit and explicit measures of autonomous and controlled motivation on behaviour. Measures of implicit autonomous and controlled motivation were developed based on the go/no-go association task (GNAT). A series of hypotheses based on the premises of a dual-systems model were proposed and systematically tested in a prospective study of 20 health-related behaviours.

Our first hypothesis (H_1) proposed that implicit measures of motivation would provide a unique, independent prediction of behaviour. Overall, there was limited support for the direct effect of implicit measures of motivation on behaviour across the 20 behaviours. There was the significant, independent effect of implicit autonomous motivation for the tooth brushing and posture behaviours, and for implicit controlled motivation in the alcohol consumption and caffeine reduction. To some extent, this outcome reflects the mixed findings in the research on implicit influences on behavioural engagement (see Levesque et al., 2008 for review). Therefore, the impulsive route in the proposed dual-systems model was only supported in a small subset of behaviours in the current research. This likely reflects the type of motivational process typically involved in the enaction of the behaviours. Behaviours that require less planning, or are more spontaneously or automatically performed were better predicted by the implicit measures of motivation.

Further hypotheses related to the predictive role of explicit measures of motivation from self-determination theory and intention on each of the behaviours. Dual-systems models (Strack & Deutsch, 2004) and previous research (Ajzen, 1991, 2002; Hagger et al., 2006a) suggested that explicit measures should predict intention (H_2); this was the case for over half of the behaviours for autonomous motivation, and for half of the behaviours for controlled motivation. Furthermore, support was found for the hypothesis that intention would mediate the explicit measures of autonomous motivation to behaviour link for over half of the behaviours (H_3). Overall, this gives some support for the proposed dual-systems framework, a key premise of which is that both impulsive and reflective systems should each provide unique contribution to the prediction of behaviour, but the reflective system is mediated by variables that represent deliberation and planning such as intention. However, contrary to our hypothesis (H_4), explicit measures did provide direct prediction of several behaviours. A possible explanation for this was outlined by Hagger, Chatzisarantis, and Harris (2006). Essentially, it is possible that the direct relations between motivational orientations and behaviour are not adequately captured by measures of behavioural intention, or may indeed reflect more spontaneous, less-conscious influences of motives on performances.

Generally, the prediction of behaviour by implicit measures of motivation suggests that initiation of behaviour can be influenced by impulsive processes. These processes are likely to have been reinforced through previous experiences and outcomes (Strack & Deutsch, 2004). In the current study, our

GNAT measures provided generalized implicit measures of individuals' autonomous and controlled motivation orientation. Therefore, the negatively-valenced prediction of alcohol consumption by our implicit measure of controlled motivation likely means that a tendency to be controlled by external factors will lead to less alcohol consumption. This is probably because people who have a predominant controlled-oriented motivational orientation are most likely to have had alcohol abstinence externally reinforced in previous situations. Similarly, a positive prediction of posture by implicit measures of autonomous motivational orientation indicates a tendency to attain a correct sitting posture through previous autonomous experiences which emphasize the personally-referenced value attached to the outcome of sitting in the correct position (e.g., maintaining good health, minimizing pain). Essentially, an autonomously-oriented individual may have incorporated correct posture into their repertoire of personally-endorsed behaviours. For example, toothbrushing is habitual and performed without planning or conscious deliberation, and is therefore more likely to be predicted by implicit measures of motivation from self-determination theory.

Predictions by explicit measures likely reflect behaviours that are performed as a result of deliberative decision-making processes to behave in a particular way. For example, prediction of reducing caffeine intake by the explicit measure of controlled motivation indicates a tendency to reduce the intake of caffeine as a result of conscious, deliberative factors that are externally endorsed. Washing hands before handling food may be explained in terms of explicitly-measured forms of autonomous motivation as individuals

are likely to have reflected on the benefits of hand hygiene and the associated personally-value outcomes of the behaviour. The role of intention as a mediator between the explicit measures of motivation and behaviour is indicative of behaviours for which planning serves an important function in the performance of the behaviour (e.g., exercising, taking a walk to provide a break from work)[5].

Though the behaviours were initially chosen based on previous research in the area, and feedback from an initial piloting stage, future research should seek to clarify exactly what types of behaviours are being researched. For instance, in the current set of 20 behaviours, there are some that are more likely to be underpinned by reflective, planned processes (e.g., planning work, planning dietary goals, or taking walks). Several of the behaviours, as outlined previously, also may be more spontaneously performed, or are more habitual and thus automatically performed (e.g., brushing teeth, sitting with correct posture). There was no obvious grouping of behaviours into these dimensions in the current research; however, future research could deliberately test this possibility by changing the wording of performance of behaviours, or specifically testing the difference between habitual behaviours and those requiring more conscious planning.

[5] Brushing your teeth is a routine that is carried out on a regular basis, with comparatively less forethought or planning than other behaviours such as stair climbing. To this extent, toothbrushing should fall into the domain of the impulsive system, given its automaticity. In contrast, climbing stairs may depend on a number of reflective processes. For instance, if someone is actively trying to increase light exercise in the day, is rushed to get somewhere, or simply has an ache in their leg making them reconsider whether climbing stairs is possible, these contingencies may require more cognitive involvement in the decision-making process and making it a more reflective process

Though the current study had a relatively small sample size; bootstrap statistics should help with this issue. A further limitation of the current study is that the GNAT measure of motivational orientations developed for this study may not fully or adequately capture the implicit motives from self-determination theory. Although the GNAT was developed and analyzed according to previous research and adopted recommended algorithms, results cannot unequivocally support the predictive validity of this measure without further corroborating evidence. It should be noted, the literature has been impeded by a lack of consistency in the types of measurement instruments to tap implicit processes. This appears to be the case for studies using implicit processes in self-determination theory. For example, the measure used by Burton et al. (2006) adopted a lexical decision task, which is structurally different to the GNAT, while Levesque and Brown (2007) used an implicit association test which did not permit the distinction between autonomous and controlled forms of implicit motivation separately; rather, the two constructs were conceptualized as a bipolar continuum. Therefore, although this research may tap the same construct, the inconsistencies in the measures and their inherent drawbacks mean that it is difficult to draw definitive comparisons across the literature as to the effects of implicit motivational constructs on behaviour. The current research is therefore important in being the first to incorporate separate measures of implicit autonomous and controlled forms of motivation. At this stage, however, it was deemed more appropriate to incorporate a more widely used and supported implicit measure in future research. To this extent, the follow-up study conducted investigated the predictive validity of the implicit association test (IAT; Greenwald et al.,

1998), which is a more widely-used measure, and has been previously used as an implicit measure of motivation (Levesque & Brown, 2007).

Conclusion

In conclusion, the current study provided some limited support for the use of implicit measures of forms of motivation from self-determination theory and the adoption of a dual-process model of behaviour with respect to these forms motivation on health behaviours. Though present data demonstrate that behavioural prediction is far more effective through explicit measures of motivational constructs from self-determination theory, there were some behaviours in which implicitly-measured forms of motivation affected behaviour. While theories of goal-oriented behaviour have traditionally adopted an explicit approach, the current research demonstrated the existence and importance of implicit processes underlying behaviour. It was therefore deemed necessary to further investigate the role of implicit processes underlying behaviour in a follow-up study.

Chapter 3

Investigating the Predictive Validity of Implicit and Explicit Measures of Motivation on Condom Use, Physical Activity, and Healthy Eating

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Chapter 3: Investigating the Predictive Validity of Implicit and Explicit Measures of Motivation on Condom Use, Physical Activity, and Healthy Eating

Introduction

The aim of the second study was to extend the findings of the first study (reported in Chapter 2) and provide further support for the role of implicit processes in self-determination theory. Furthermore, given the possible limitations of the implicit measures used in the first study (the GNAT), the current study instead used a more widely supported implicit measure, the implicit association test (Greenwald et al., 1998). The current study, therefore, also allows a further test of the suitability of dual-systems models as conceptual frameworks for understanding the relationship between reflective and impulsive processes in human motivation. A subset of previously measured health-related behaviours was investigated, in order to provide a clearer account of the predictive validity of implicit and explicit measures. A possible limitation of the previous study was including so many different behaviours, with little consideration of the type of behaviour being investigated. The current behaviours were chosen as they have all been investigated previously in relation to implicit processes (e.g., Czopp et al., 2004; Marsh, Johnson, & Scott-Sheldon, 2001; Richetin, Perugini, Prestwich, & O'Gorman, 2007). These previous studies, however, have focused more on the relation between implicit attitudes regarding the behaviour and actual behavioural engagement. The present study therefore provides an important contribution to the literature in assessing whether implicit motivation also

provides significant prediction of behavioural engagement with the target behaviours.

A similar model to the one previously used (See Chapter 2) was again developed to provide an account of the expected relationships between implicit motivation, explicit motivation, and health-related behaviour. From this framework, a number of hypotheses were derived. First (H_1), it was predicted that an implicitly-measured autonomous motivation construct would have a direct, unique effect on behaviour, independent of explicitly-measured motivational constructs. This hypothesis was based on previous studies indicating direct effects of implicit measures on health-related behaviours (Czopp et al., 2004; Marsh et al., 2001). Second (H_2), it was predicted that intention would provide a valid prediction of behaviour. This hypothesis is based on previous research adopting social cognitive models such as the theory of planned behaviour (Ajzen, 1991), which propose that intentions are the most proximal determinant of behaviour in the reflective system and will provide consistently valid prediction of behaviour (Ajzen & Fishbein, 2009). A further hypothesis (H_3) was that intention would mediate the effect of explicitly-measured motivational constructs on behaviour based on the hypotheses of intentional theories and supported by empirical findings (Back et al., 2009; Bagozzi, Baumgartner, & Yi, 1989; Fishbein & Ajzen, 2009).

Method

Participants

Undergraduate students (N = 162; 101 female, 61 male, M_{age} = 22.12, range: 18-44 years) participated in the current study. Only 150 participants'

data were analysed, due to twelve failing to complete the follow-up. Students eligible to participate in the study were contacted via email with study details and provided with the opportunity to participate. A £4 inconvenience allowance was administered in return for participation. The study protocol was approved by the School of Psychology Ethics Internal Review Board at the University of Nottingham.

Materials

Implicit motivation. Implicit autonomous and controlled motivational orientations were measured using the implicit association test (IAT). Words representing intrinsic (choice, free, spontaneous, willing, authentic) and extrinsic (pressured, restricted, forced, should, controlled) motivation were taken from research conducted by Levesque and Brown (2007). These words were shown to offer a distinct representation of the two orientations. Words pertaining to 'self' (I, me, my, mine, self) and 'others' (others, they, them, their, theirs) were also adopted from Levesque and Brown's lists. The label 'others' was adopted because it was more easy to distinguish from the label 'self' than 'non-self' was from 'self'. Previous researchers have also used these category headings in the context of the IAT (e.g., Brunstein & Schmitt, 2004). The category 'others' was fully explained to participants as reflecting a 'not-self' category, rather than a more generalized social-comparison category. The standard five-step IAT was used in which blocks 1, 2, and 4 were practice, each lasting 20 trials; test blocks (3 and 5) comprised 60 trials – 20 practice and 40 test (see Table 1). The IAT measure was calculated using the improved

D-score algorithm(Greenwald et al., 2003). Coding was such that higher scores were indicative of an autonomous motivational orientation.

Perceived locus of causality. Participants' explicit contextual-level forms of motivation based on the perceived locus of causality (PLOC) was measured through an adaptation of Ryan and Connell's (1989) PLOC scale. It was deemed important to evaluate the implicit measure alongside previously-adopted explicit measures in order to gain insight into the extent to which the implicit measure explains unique variance beyond the explicit measures. This would then have direct implications for advancing knowledge of the areas as it will provide some evidence to evaluate the extent to which the findings from previous research using these explicit measures would differ were implicit measures of autonomous motivation included (see McClelland, 1985). A common stem for each behaviour was given (e.g., "I exercise regularly (3-4 times a week) because..."). A series of reasons, four per regulation type, relating to the various forms of motivation was then listed (e.g., intrinsic motivation: "I enjoy ..."; indentified regulation: "I think it is important to..."; introjected regulation: "I feel under pressure to..."; extrinsic regulation: "I will feel ashamed if I do not..."). These were measured on a four-point Likert-type scale ranging from *not true at all* (1) to *very true* (4).

The PLOC scales were converted into weighted means representing controlled and autonomous motivation. The index for controlled motivation was calculated as the extrinsic regulation items, weighted by a factor of 2, added to introjected regulation items. This calculation was then repeated for

the index of autonomous motivation; items measuring intrinsic motivation were weighted by 2, and added to an identified regulation items. This produced separate scales for each motivational form and reduced the number of overall variables making interpretation of analysis clearer. For example, autonomous motivation item 1 = (identified item 1 x 1) + (intrinsic item 1 x 2); autonomous motivation item 2 = (identified item 2 x 1) + (intrinsic item 2 x 2) and so on. The same analysis was conducted for controlled motivation items (Cronbach's α for both scales = .71).

Intention. Intentions to perform the behaviours were measured using two items (e.g., "I intend to..." and "I plan to..."; inter-item correlations for all behaviours were > .90). Responses were given on seven-point Likert-type scales from *unlikely* (1), to *very likely* (7).

Self-reported behaviour. Participants gave self-reports of their performance for each of the behaviours (e.g., "In the past 4 weeks, how often have you eaten at least five portions of fruit and vegetables?") using seven-point Likert-type scales from *never* (1) to *almost everyday* (7). The criterion and concurrent validity of this measure has been verified against objective measures (Chatzisarantis, Hagger, Smith, & Phoenix, 2004; Hagger et al., 2006a; Norman et al., 2010).

Procedure

The study adopted a prospective design with psychological measures administered at an initial time point and follow-up self-reported measures of behaviour taken at a second point in time, four weeks later. All participants were tested in isolation in a sound-proofed experimental cubicle. After information on the experimental requirements was given, and informed consent gained, they were left to complete the study. A researcher was close-by at all times in case further assistance was required. Participants completed the IAT administered using E-Prime experimental software. Further instructions and guidance was offered through the E-Prime introduction screens, as well as the standard practice trials within the program. The IAT procedure lasted approximately five minutes. After completion of the implicit measure, participants were asked to move on to the questionnaire, also administered using the E-Prime software, which lasted approximately 20 minutes. Trials were fully counterbalanced such that half the participants conducted the implicit measure first, while the remainder completed the explicit measures first. Participants were contacted via email or telephone, depending on personal preference, and their performance of the behaviours was subsequently assessed, four weeks later. After completion of the follow-up questionnaire, the aim of the study was explained and any further questions answered to the satisfaction of all participants.

Results

Preliminary analyses

The improved scoring algorithm (Greenwald et al., 2003) was used to calculate the implicit motivation score from the IAT data. No participants were eliminated due to having more than 10% of scores sub-300 ms; no values exceeded 10,000ms. *D*-scores were calculated such that higher scores were indicative of a higher level of implicit autonomous motivation orientation. Descriptive statistics and Zero-order correlations (see Table 4) were computed between the implicit measure of self-determined motivation (IAT-*D* score), explicit measures of self-determined and controlled motivation, and outcome behaviours. For all behaviours, intention and explicit measures of motivation were significantly correlated. The implicit measure (IAT-*D* score) of autonomous motivation correlated significantly with explicit controlled motivation for the condom use and physical activity behaviours

Predicting Behaviour

Hierarchical regression analyses were conducted to assess the unique contribution of the implicit and explicit motivational measures (step 1) and intention (step 2). Standardized regression coefficients and R^2 values from the regression analyses are shown in Table 2[6]. Sobel (1982) tests were used to provide a formal test of the indirect effect of explicit measures of autonomous and controlled motivation on behaviour through intention.

[6] There is a possible issue of scale correspondence, in terms of aggregated and disaggregated implicit and explicit measures. Essentially, the IAT provided a relative measure of implicit autonomous motivation, whereas separate explicit measures of autonomous and controlled motivation were tested. However, in previous research (Chapter 2), the issue of scale correspondence was not an issue.

Table 4. Descriptive statistics and Zero-Order Correlations Among Study Variables

	Descriptive statistics		Zero-order Correlations			
Variables	Alpha (MIC)	Mean (S.D.)	1	2	3	4
1.Autonomous	.71	5.41 (1.55)	–			
Motivation	.77	5.88 (1.78)				
(Explicit)	.71	6.03 (1.65)				
2.Controlled	.79	6.94 (1.21)	.52**			
Motivation	.78	6.31(2.00)	.30**	–		
(Explicit)	.80	5.64 (1.99)	.39**			
3.IAT	.68+	-	-.04	.17*		
(Implicit)			-.02	-.02	–	
			.09	.03		
4. Intention	.	5.17 (2.24)	.43**	.50**	.13	
	.	5.23 (1.63)	.73**	.37**	.05	–
	.	5.40 (1.42)	.73**	.34**	.11	
5. Behavior	.	4.12 (1.24)	.24*	.47**	-.13	.69**
	.	4.11 (1.83)	.41**	.24**	.18*	.53**
	.	4.31 (1.92)	.48**	.19*	.05	.54**

Note. In each cell, row 1 = condom use (N= 73), row 2 = physical activity (N = 150), row 3 = fruit and vegetable consumption (N = 150); IAT = Implicit Association Test *D*-score representing generalized implicit measure of autonomous motivation; Intention = mean of intention and planning to conduct behavior over a 4-week period; Behavior – self-reported behavioral enactment over a four-week period.

+The alpha score for the IAT is a split-half reliability.

** $p < .05$. ** $p < .01$

Table 5. Hierarchical Multiple Regression Analyses predicting Condom use, Physical Activity, and Fruit and Vegetable Consumption

	Condom			Physical Activity			FruitVeg		
Predictor	R^2	β	*t*, *p* values	R^2	β	*t*, *p* values	R^2	β	*t*, *p* values
Step 1	.26			.22			.23		
IAT		.18	$t = 1.75, p = .09$		.19*	$t = 2.53, p = .01$		-.01	$t = -0.17, p = .86$
Aut		.10	$t = 0.87, p = .39$		.37**	$t = 4.82, p < .01$		.49**	$t = 6.13, p < .001$
Con		.41**	$t = 3.44, p < .001$		.13	$t = 1.69, p = .09$		-.01	$t = -0.10, p = .92$
Step 2	.49			.31			.31		
IAT		.09	$t = 1.04, p = .30$		.17*	$t = 2.47, p = .02$		-.04	$t = -0.52, p = .60$
Aut		-.03	$t = -0.31, p = .76$		.03	$t = 0.30, p = .76$		.22*	$t = 2.19, p = .03$
Con		.13	$t = 1.20, p = .23$		.04	$t = 0.56, p = .58$		-.04	$t = -0.49, p = .63$
Intention		.61**	$t = 5.53, p < .001$		.49**	$t = 4.54, p < .001$		.39**	$t = 3.97, p < .001$
n	73			150			150		

Note. IAT = Implicit Association Test *D*-score representing generalized implicit measure of autonomous motivation. Aut = explicit measure of autonomous motivation; Con = explicit measure of controlled motivation; Intention = behavioral intention to conduct behavior over a 4-week period; Condom – Condom use over a four-week period; Physical Activity = regular exercise over a four-week period; FruitVeg – Eaten at least 5 portion of fruit and vegetables, per day, over a four-week period. It should also be noted that the IAT score was a generalized score of individuals' implicit motivation, rather than a domain-specific score. Furthermore, non-corresponding content-domain correlations are excluded from the table. ** $p < .05$. ** $p < .01$.

Condom use. The effect of the hypothesized predictor variables on condom use in the first step was significant ($R^2 = .26, p < .001$), $F(3, 73) = 8.37, p < .001$. The effect of the implicit measure (IAT score) on condom use behaviour did not reach the 0.05 alpha criterion for significance and on this basis our hypothesis (H_1) had to be rejected[7]. The explicit autonomous motivation scale was not a significant predictor of behaviour, but explicit controlled motivation provided a significant prediction ($\beta = .41, p < .001$). There was a significant change in R^2 in the second step ($\Delta R^2 = .23, p < .001$), $F(4, 73) = 16.56, p < .001$. Intention was the sole significant predictor of behaviour ($\beta = .61, p < .001$), while explicit controlled motivation was no longer a predictor. This indicated that condom use was determined by explicitly-measured intention as predicted (H_2). Sobel (1982) tests indicated that intention mediated the relationship between explicitly-measured autonomous motivation and behaviour (standardized regression coefficients: autonomous motivation→intention, $\beta = .24, p = .003$; intention→behaviour, $\beta = .61, p < .001$, autonomous motivation→behaviour, $\beta = -.03, p = .76$; autonomous motivation→ behaviour (controlling for intention): $\beta = .15, p > .05$; $z = 1.94, p > .05$). Intention also significantly mediated the effect of explicitly-measured controlled motivation on behaviour (standardized regression coefficients: controlled motivation →intention, $\beta = .36, p < .001$; intention→behaviour, $\beta = .61, p < .001$; controlled motivation→behaviour, $\beta = .13, p = .23$; controlled

[7] It should be noted that the size of the effect ($\beta = .18$) and associated probability value ($p = .09$) indicated that the effect did, in fact, exist but the present study was underpowered.

motivation→ behaviour (controlling for intention): $\beta = .22, p < .001$; $z = 3.24$, $p < .001$). Hypothesis (H_3) was therefore supported for condom use as intention mediated the relationship between both autonomous and controlled motivation and behaviour.

Physical activity. There was a significant effect of the hypothesized predictors and physical activity behaviour in the first step ($R^2 = .22, p < .001$), $F(3, 149) = 13.51, p < .001$. The regression coefficient for implicit autonomous motivation was significant ($\beta = .19, p = .01$), supporting hypothesis (H_1). The explicit controlled measure did not significantly predict physical activity behaviour. Explicit autonomous motivation, however, did significantly predict behaviour ($\beta = .37, p < .001$). There was a significant change in R^2 in the second step ($\Delta R^2 = .01, p < .001$), $F(4, 149) = 16.65, p < .001$. Intention provided a significant prediction of behaviour ($\beta = .49, p < .001$), as hypothesized (H_2). Sobel (1982) tests indicated intention significantly mediated the relationship between explicitly-measured autonomous motivation and behaviour (standardized regression coefficients: autonomous motivation→intention, $\beta = .68, p < .001$; intention→behaviour, $\beta = .49, p < .001$, autonomous motivation→behaviour, $\beta = .03, p = .76$; autonomous motivation→behaviour (controlling for intention): $\beta = .33, p < .001$; $z = 3.79, p < .001$). Intention also significantly mediated explicitly-measured controlled motivation (standardized regression coefficients: controlled motivation→intention, $\beta = .17, p < .001$; intention→behaviour, $\beta = .49, p < .001$; controlled motivation →behaviour, $\beta = .04, p = .58$; controlled motivation→ behaviour (controlling for intention): $\beta = .08, p < .001$; $z = 2.73$,

$p < .001$). This provides support for hypothesis (H_3), as intention mediated the explicit measure-behaviour relationship

Fruit and vegetable consumption. The effect of the hypothesized predictor variables on fruit and vegetable consumption resulted in a significant regression equation in the first step ($R^2 = .22, p < .001$), $F(3, 149) = 14.94, p < .001$. The implicit measure of motivation did not provide significant prediction of behaviour, thus failing to support hypothesis (H_1). Explicit autonomous motivation significantly predicted behaviour ($\beta = .49, p < .001$). There was a significant change in R^2 in the second step ($\Delta R^2 = .08, p < .001$), $F(4, 149) = 16.27, p < .001$. Intention significantly predicted behaviour ($\beta = .39, p < .001$), as hypothesized (H_2); explicit autonomous motivation also remained a significant predictor of behaviour ($\beta = .22, p = .03$). Sobel (1982) tests indicated that intention partially mediated the relationship between explicitly-measured autonomous motivation and behaviour (standardized regression coefficients: autonomous motivation→intention, $\beta = .69, p < .001$; intention →behaviour, $\beta = .40, p < .001$, autonomous motivation→behaviour, $\beta = .22, p = .03$; autonomous motivation→ behaviour (controlling for intention): $\beta = .28, p < .001$; $z = 2.88, p < .001$). Intention, however, did not significantly mediate explicitly-measured controlled motivation (standardized regression coefficients: controlled motivation on intention, $\beta = .07, p = .24$; intention on behaviour, $\beta = .40, p < .001$; controlled motivation on behaviour, $\beta = -.04, p = .63$; controlled motivation→ behaviour (controlling for intention): $\beta = .03, p > .05$; $z = 1.45, p > .05$). This provides only partial support for our hypothesis (H_3).

Discussion

The aim of the present research was to examine the independent effects of implicit and explicit measures of autonomous and controlled motivation on health-behaviours using a dual-systems model (Strack & Deutsch, 2004) as a framework. A series of hypotheses, based on dual-systems models and self-determination theory, were proposed and systematically tested in a prospective study of three health-related behaviours: condom use, physical activity, and fruit and vegetable consumption. Our first hypothesis (H_1) was that implicit measures of autonomous motivation (measured by the IAT) would provide unique and independent prediction of behaviour. A significant effect was found for the effect of implicitly-measured autonomous motivation for physical activity behaviour and there was a trend toward an effect for condom use, but the study was not sufficiently powered. No effect was found for implicit autonomous motivation on fruit and vegetable consumption. Present findings did not provide unequivocal support for the impulsive route to behaviour, derived from dual-systems models, as the effect was significant in only one of the behaviours investigated. Intention consistently predicted all behaviours, supporting our second hypothesis (H_2). This corroborates previous research that intention is the most proximal predictor of planned behaviour, predictions (Ajzen, 1991; Back et al., 2009; Fishbein & Ajzen, 2009). Sobel tests also indicated that intention significantly mediated the relationship between explicitly-measured motivational constructs and behaviour for all but one of the hypothesized paths, supporting hypothesis (H_3) and previous research (Fishbein & Ajzen, 2009; Hagger et al., 2006a).

The present research provides only limited support for the RIM (Strack & Deutsch, 2004). The prediction of behaviour by implicit autonomous motivation was confined to physical activity in the present study and suggests that enactment of this behaviour may, in part, be influenced by non-conscious, automatic processes. However, the implicit association test for autonomous motivation developed and used in the present study did not predict condom use and fruit and vegetable consumption. A possible reason for this is that neither of these behaviours are strongly influenced by generalized, dispositional, and distal motivational orientations that affect behaviour beyond an individuals' awareness, as measured by the implicit motivational orientation. Instead, these behaviours are likely to be predominately determined by contextual, proximal influences that are planned and consciously determined. This is also generally the case with physical activity, which was also predicted by explicit autonomous motivation alongside the implicit route. This suggests that this particular behaviour may have both implicit and explicit routes to behavioural enactment. On the whole, similar to the 20 behaviours in Study 1, the choice of which behaviours to investigate should be considered in future research. Ideally, choosing some behaviours that are more spontaneous in their initiation (e.g., habitual behaviours) and measuring them alongside more planned behaviours (e.g., work timetabling) will provide a stringent test of the specificity of implicit measures to predict spontaneous behaviours in contrast to planned behaviours. Within the current study, the aforementioned reasons outline why condom use and eating fruit and vegetables may not have been predicted by implicit measures of motivation (e.g., they are planned,

considered lifestyle choices); whereas performance of physical activity could be evoked without planning (e.g., spontaneous games of football, or other outdoor group activities).

Intention is proposed as the final mechanism in the reflective system (Strack & Deutsch, 2004) and, consistent with this hypothesis, the inclusion of intention in the regression analyses in the current study resulted in the most pervasive prediction of behaviour, especially behaviours likely to require planning in terms of when to conduct the behaviour and what actions are needed to conduct the behaviour. For example, the indirect, intention-mediated path for physical activity indicated that the effect of explicit autonomous motives to pursue physical activity was a deliberative process. Physical activity, like going to the gym, or playing a game of football entails planning equipment to use and making arrangements and there is, therefore, a stage of deliberative planning before performance of the activity as implied by the mediated path from autonomous motivation via intentions. Similarly, for fruit and vegetable consumption, the explicit autonomous motivation measure and behaviour relationship was significant, indicating partial mediation by intention. As with physical activity, the indirect path suggests that those motivated to eat fruit and vegetables for autonomous motives need to engage in deliberative, intentional thought prior to engaging in behaviour. An explanation of the direct relationship may be that intentions did not adequately capture the effects of the explicit motivational orientation on behaviour; or, this reflected more spontaneous, less deliberative influences of motives on behaviour (Hagger et al., 2006a). These results suggest that it is important to

identify the characteristics of the behaviour being investigated in terms of the inherent level of deliberation or spontaneity required for its enactment. Variation in terms of some behaviours being more spontaneous (e.g., having another drink at a bar when offered) compared to others that are more deliberative (e.g., attending a gym for a workout), should be taken into account in studies comparing the relative strength of the effects of implicit and explicit measures of motivation on behaviour.

Conclusion

Both this and the previous study provided largely inconsistent findings in terms of overall support for implicit measurement of motivation for health-related behaviours. However, a possible explanation for this may be the nature of the behaviours being investigated. Most of the health behaviours involve some degree of planning and deliberation in their initiation and performance. The consistently significant role of intention in the models supports the theory that in order to perform these behaviours, participants needed to form reflective plans and strategies. There is a possibility that the behaviours are not conducive to showing the role of the impulsive system, therefore implicit measures of motivation are likely to not offer valid predictions of behaviour. The double-dissociation pattern (i.e., explicit measures predicting more deliberative, planned behaviours, and implicit measures predicting more spontaneous, unplanned behaviours) has been raised previously in the literature (Keatley, Clarke, & Hagger, in press-b). In order to further test this pattern, a number of studies were developed involving unplanned behaviours, thus possibly providing a fairer test for implicit measures of motivation.

Chapter 4

Investigating the Predictive Validity of Implicit and Explicit Measures of Motivation in Problem-Solving Behavioural Tasks

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Chapter 4: Investigating the Predictive Validity of Implicit and Explicit Measures of Motivation in Problem-Solving Behavioural Tasks

Introduction

The aim of this research was to continue investigating the effects of implicit and explicit processes of motivation in terms of Strack and Deutsch's (2004) dual-systems model. Given the findings of the previous studies (Chapters 2 and 3), the current studies focused on a different type of outcome behaviour – ones that could be measured more objectively, rather than through self-reports. This was deemed appropriate in order to address the issue of correspondence between measure and outcome, and to assess alternative patterns of prediction (such as double-dissociation). Over two separate studies, we used the implicit association test (IAT; Greenwald et al., 1998), alongside explicit measures of motivation to assess individuals' self-determined forms of motivation to persist on novel problem-solving tasks (a figure-tracing task and an anagram task) in a free choice paradigm - freely chosen time spent on an activity. The current research makes an important contribution to the literature by formally addressing the possibility of a correspondence bias in studies incorporating explicit measures of motivation and explicit self-reported measures of behaviour. As the current studies use a free-choice paradigm, this offers an objective measure of behavioural persistence in a neutral behavioural context. This provides a valid behavioural outcome measure that will enable us to evaluate the relative predictive validity of implicitly- and explicitly-measured forms of self-determined motivation. Furthermore, the current studies provide a clearer indication of the suitability of a dual-systems

approach to explain the psychological processes that underpin motivated behaviour.

Given the findings from the previous studies (See Chapters 2 and 3), it was deemed important to investigate whether implicitly measured motivation provided increased predictive validity for behaviours that were novel and did not contain an element of pre-planning. In addition, to continue providing unique contributions to the literature, it is important to investigate the predictive validity of implicit measures of motivation for problem-solving behaviours, rather than focusing solely on health behaviours. Therefore, the first study in this chapter used a figure-tracing task, which has previously been used in the literature (Baumeister et al., 1998). This task was chosen as previous research has shown that an individual's motivation orientation, explicitly measured, predicts how long they will spend completing the task in a free-choice paradigm. It is important to measure whether implicit measures of motivation provide additional predictive validity for the behaviour. An additional advantage in the current research was that participants were unaware of what the problem-solving behaviours were before starting the study. Therefore, the initiation of these behaviours was unplanned. Essentially, participants would not have had the opportunity to plan, or deliberate how to do the behaviours before starting that section of the study. Therefore, the outcome behaviours should provide a fairer test for the implicit measure.

This chapter reports two studies that investigated the role of implicit forms of autonomous motivation, derived from self-determination theory, in the prediction of behavioural engagement for novel problem-solving tasks. The research is informed by a dual-systems model that outlines patterns of effects

for implicit and explicit motivational processes in the prediction of behavioural engagement. Based on this framework, a number of hypotheses were formulated. First, it was predicted (H_1) we proposed that the implicit measure of autonomous motivation would provide direct, unique prediction of behaviour, independent of explicit measures. This hypothesis was based on previous studies indicating the unique effects of implicit processes (Czopp et al., 2004; Keatley, Clarke, & Hagger, 2012) . A further hypothesis (H_2) was that explicit measures of autonomous motivation would provide unique prediction of behavioural engagement. This was based on previous research which supports the predictive validity of explicit measures of autonomous motivation across numerous behaviours (Chatzisarantis et al., 2003; Moller et al., 2006). In a third hypothesis (H_3), we proposed that there would be an interaction between implicit and explicit measures of autonomous motivation. This was primarily based on Perugini's (2005) research, which supported the premise proposed in dual-systems models that the implicit and explicit antecedents of behaviour may interact. An interaction effect would likely indicate that persistence with the task is the outcome of a synergy between explicit and implicit processes, such that those who are explicitly and implicitly autonomously-oriented will spend longer at the task than those who are autonomously motivated for one of the forms of motivational orientations alone (Strack & Deutsch, 2004).

Study 3.1

The aim of study 3.1 was to test the suitability of a dual-systems model for explaining the effects of implicit and explicit forms of autonomous motivation from self-determination theory on behavioural persistence on a

novel problem-solving task. Time-spent on a figure-tracing task presented a free-choice period (Baumeister et al., 1998; Moller et al., 2006) was used as a behavioural measure of individuals' autonomous motivation.

Method

Participants

Undergraduate students (N = 72; 46 female, 26 male, *M* age = 20.53, age range: 18-46) from the University of Nottingham participated in the study. Students were contacted via emails detailing the study and the opportunity to participate. An inconvenience allowance of £4 was provided for participation. The study protocol was approved by the School of Psychology Ethics Committee at the University of Nottingham.

Materials

Implicit Association Test (IAT). The IAT was the same as previous studies.

General Causality Orientations Scale (GCOS). The GCOS is an individual difference measure of participants' relatively enduring autonomous and controlled motivational orientations from SDT (See Appendix 4 for Study questionnaire). The scale comprised 12 vignettes relating to typical social or achievement oriented situations. Each vignette was followed by statements that distinguished between autonomy and controlled orientations. Participants indicated their responses on a seven-point Likert-type scale ranging from 1

(*very unlikely*) to 7 (*very likely*). Cronbach's alpha scores are presented in Table 6.

Intrinsic Motivation Inventory (IMI)[8]. The IMI (Ryan, 1982) is a multidimensional measure of participants' subjective experience of a target task, in this case the figure-tracing task. The inventory comprises twenty-two scales that are aggregated into several subscales pertaining to autonomous (interest/enjoyment, perceived competence, and choice) and controlled (pressure/tension) forms of motivation with respect to the target task. Participants rated items with respect to the figure-tracing task using a seven-point Likert-type scale ranging from 1 (*not at all true*) to 7 (*very true*). Cronbach's alpha scores are presented in Table 6.

Procedure

Participants were invited into the laboratory and tested individually. After participants had received information about the study and signed an informed consent form, the researcher administered the figure-tracing task. The task required participants to trace several geometric figures without lifting their pencil from the page once they had begun, and without retracing any line once it had been drawn. Participants first completed two solvable practise figures, with the researcher present to answer any questions, in order to confirm they

[8] The IMI scales are used here as predictors of behaviour; however it should be noted that there is debate over whether they can be meaningfully used as predictors. The IMI needs to be measured post-behaviour, and therefore creates issues when entering it as a predictor. Additional analyses were conducted in which IMI scales were entered as outcome variables and time spent on the tasks, IAT and GCOS variables entered as predictors of IMI scores. For all scales across both studies, there was no significant prediction of IMI scales by time, IAT, and GCOS.

understood the rules and procedure. Multiple slips of paper were made available for each attempt. After completion of the practice trials, the researcher gave participants the test figures and then gave the same instructions for the figure tracing task given by Moller et al. (2006). Participants were not aware that the test figures had been prepared so as to be impossible to solve. The researcher then left the room and timed the duration participants worked on the puzzles before giving up. Twenty minutes was set as the maximum time; any participants still working at this time were told to move on to the questionnaire[9]. Once the participants had signalled that they would like to stop, by calling the research back, the researcher entered the room and administered a two-minute filler task followed by the measures of motivation. The order of presentation of the implicit and explicit measures was counterbalanced.

Results

Preliminary analyses

The improved scoring algorithm (Greenwald et al., 2003) was used to initially process IAT data. No participants were eliminated due to having more than 10% of scores sub-300 ms; no values exceeded 10,000ms. *D*-scores were calculated such that higher scores were indicative of a higher level of implicit autonomous motivational orientation.

[9] Some participants persisted to the full time limit raising the possibility of a ceiling effect in the persistence measure. As a result we performed a test for skewness which yielded values of .42 and -.40 in Studies 1 and 2 respectively, which is within the cutoff score suggested by Kline and Santor (1999) of an absolute value of ±3.0. We concluded that the behavioural measure was not affected by departures from normality.

Descriptive statistics and Zero-order correlations among the study variables are provided in Table 6. These provided initial indication of the pattern of relationships among the implicit and explicit measures of autonomous and controlled motivation and the behavioural measure of time spent on the task. The implicit measure of motivation significantly correlated with time spent on the task (r = .30, p =.011), and was negatively correlated with IMI-competence (r = -.27, p = .017). IMI-enjoyment (r = .27, p = .023) and IMI-competence (r = -.28, p = .023) were also significantly correlated with time spent on the task. There were no other statistically significant correlations.

Predicting Behaviour

Hierarchical multiple regression analysis was conducted to investigate the predictive validity of implicit measures of motivation offer additional prediction of behaviour beyond explicit measures of motivation on the figure-tracing task. Therefore, explicit measures were entered in step 1, and IAT scores in step 2. Standardised regression coefficients and R^2 values from the

Table 6. Summary of Descriptive Statistics and Intercorrelations for Study Variables

	Descriptives (study 1)											Descriptives (Study 2)	
Variable	α^a	Means (S.D.)	1	2	3	4	5	6	7	8	9	α^b	Means (S.D.)
1. IAT	.56	-	-	.008	-.007	-.159	.007	-.096	-.064	.005	.301**	.58	-
2. IMI enjoy	.72	4.18 (1.03)	-.058	-	.382**	.466**	-.125	.097	-.117	.091	.237*	.93	4.07 (1.15)
3. IMI competence	.86	3.47 (1.04)	-.267*	.102	-	.333**	-.264*	.053	.168	.082	.125	.87	3.67 (1.05)
4. IMI choice	.32	3.81 (1.07)	-.052	.323**	-.079	-	-.261*	.126	.038	-.072	.048	.78	5.67 (1.02)
5. IMI pressure	.84	3.45 (.71)	.113	-.292*	-.051	-.322*	-	-.169	-.056	.035	.015	.78	2.61 (1.06)
6. GCOS autonomy	.78	5.63 (.59)	.049	.129	.089	.046	-.139	-	.152	-.396**	.027	.73	5.70 (.58)
7. GCOS controlled	.72	4.30 (.67)	-.008	.090	-.033	-.025	.257*	.144	-	.19	.245*	.77	4.17 (.80)
9. Time	-	11.58 (5.23)	.299*	.268*	-.282*	.195	-.015	.045	-.016	.003	-	-	14.24 (5.31)

Note. IAT – implicit association test; IMI – intrinsic motivation inventory; GCOS – general causality orientations scale; Time – time spent on either the figure-tracing task (Study 1) or attempting to solve the anagrams (Study 2). Intercorrelational items for psychological constructs and time measured in Study 1 are given below the diagonal, and Intercorrelations for psychological constructs and time measured in Study 2 are given above the diagonal. [a] Cronbach alpha coefficients for psychological variables measured in Study 1; [b] Cronbach alpha coefficients for psychological variables measured in Study 2.

** $p < .05$. ** $p < .01$

Table 7. Hierarchical Multiple Regression Analyses predicting Time Spent on an Unsolvable Task (Study 3.1) and a Solvable Task (Study 3.2)

	Study 1			Study 2		
Predictor	*M* (SD)	R^2	β	*M* (SD)	R^2	β
Step 1		.19			.14	
IMI enjoy	4.18 (1.03)		.30*	4.07 (1.15)		.33*
IMI competence	3.47 (1.06)		-.31**	3.67 (1.05)		-.01
IMI choice	3.81 (1.15)		.11	5.67 (1.02)		-.10
IMI pressure	3.45 (0.71		.12	2.61 (1.06)		.04
GCOS autonomy	5.63 (0.59)		.06	5.69 (0.58)		-.03
GCOS controlled	4.30 (0.67)		-.09	4.17 (0.80)		.29*
Step 2		.25*			.24**	
IMI enjoy			.30*			.30*
IMI competence			-.24*			-.01
IMI choice			.12			-.04
IMI pressure			.10			.05
GCOS autonomy			.04			-.01
GCOS controlled			-.08			.31**
IAT			.25*			.31**
n		72			73	

Note. IMI – intrinsic motivation inventory; GCOS – general causality orientations scale; IAT – implicit association test

** $p < .05$. ** $p < .01$.

regression analyses for both studies are shown in Table 7. The effect of the hypothesised predictor variables on time spent on the figure-tracing task was significant (R^2 = .25, p = .03), $F(6, 71) = 2.55$, p = .03. Explicitly measured enjoyment from the IMI provided significant prediction of time spent on the task (β = .30, p = .02), as did explicitly measured competence from the IMI (β = -.31, p = .01), supporting hypothesis (H_1). There was a significant change in R^2 in the second step (ΔR^2 = .06, p = .04), $F(7, 71) = 2.97$, p = .01. In the second step, IMI enjoyment (β = .30, p = .02) and competence (β = -.24, p = .04) remained significant predictors of behaviour; however, implicit motivation also significantly predicted time spent (β = .25, p = .04) on the task, as hypothesised (H_2). Finally, we tested the hypothesized interactions (H_3) between the implicit and explicit measures of autonomous motivation on the behaviour in an additional hierarchical multiple regression analysis following Aiken and West's (1991) procedures. Predictors were first mean-centred and then interaction terms were computed using the multiplicative composites of the implicit and each of the explicit mean-centred scores. We then ran hierarchical regression analyses entering the mean-centred implicit and explicit measures in an initial step followed by the interaction terms in a second step. Results revealed no significant interactions between IAT and any of the explicit measures for time spent on the task leading us to reject the hypothesis.

Study 3.1 Discussion

The aim of Study 1 was to test the effects of implicit and explicit measures of motivation on an objectively-measured task using a dual-systems model as a framework. Time spent solving a figure-tracing task during a free-

choice period was adopted as a dependent behavioural measure. Consistent with our hypothesis (H_1), task-specific explicit measures of autonomous motivation significantly predicted persistence. Specifically, measures of enjoyment from the IMI was a positive predictor of persistence suggesting that participants spent longer on the task because they derived an inherent satisfaction from their engagement with the task. In addition, there was a negative effect of competence from the IMI, another index of autonomous motivation, which was contrary to expectations. A possible explanation may be that participants were not able to derive a sense of competence from the task because it was impossible to solve. Therefore, the longer they spent attempting and failing at the task, the less likely they were to perceive competence on the task.

Furthermore, implicit autonomous motivation, measured by the IAT, significantly predicted persistence on the task, as hypothesised (H_2). This provides further support for the unique effect of implicit processes in novel, unplanned tasks (Brunstein & Schmitt, 2004). The lack of any significant interactions between implicit and explicit measures leads us to reject our final hypothesis (H_3). This means that the interaction model derived from the multiplicative process suggested by Perugini (2005) did not hold for the current data, indicating that the effects of implicit and explicit forms of autonomous motivation on behaviour are additive rather than interactive. The present data therefore imply that the implicit and explicit processes provide independent predictions of behaviour, and suggests that the additive rather than interactive model may provide the most effective explanation of the data.

Study 3.2

In Study 3.2, we aimed to replicate findings from Study 1 using a different problem solving task as the dependent measure. Specifically, behavioural persistence was measured using time spent solving on a series of solvable anagrams of varying difficulty (See Appendix 5) during a free-choice period. Similar to the previous study, the anagram task negates the need for self-report measures of behavioural performance, which is beneficial in overcoming measurement bias issues frequently associated with self-report dependent measures. This study is able to provide a further test of the predictive validity of an implicit measure of autonomous motivation, and therefore a fair test of the suitability of dual-systems models in providing a framework for understanding the unique effects of implicit and explicit measures of autonomous motivation on behaviour. A solvable puzzle was used in order to resolve the possible negative effect of explicit competence from the IMI on behaviour, shown in Study 1. Hypotheses were the same as those for Study 1.

Method

Participants

Undergraduate students (N = 73, 42 female, 31 male, *M* age = 23.37, age range: 18-47) from the University of Nottingham participated in the study. An inconvenience allowance of £4 was provided for participation. As before, the study protocol was approved by the School of Psychology Ethics Committee at the University of Nottingham.

Materials

Study measures were identical to those adopted in Study 3.1. Implicit autonomous motivation was measured using the IAT and explicit dispositional and task-specific autonomous and controlled motivation were measured via the IMI and GCOS inventories.

Procedure

Study 3.2 followed an identical procedure to Study 3.1. The only exception was that participants were asked to complete a solvable anagram task instead of the unsolvable figure-tracing task. The anagram task required participants to unscramble 40 different words into proper words relating to the theme of 'nature' – chosen as it was neutral with relation to the topic of motivation.

Results

Zero-order correlations among the study variables are presented in Table 6. The implicit measure of autonomous motivation ($r = .30, p = .010$) and the explicit measures of enjoyment from the IMI ($r = .24, p = .044$) and controlled motivational orientation from the GCOS ($r = .25, p = .037$) were significantly correlated with the behavioural measure of time spent on the anagram task.

Predicting Behaviour

The predictive validity of the implicit and explicit measures of autonomous motivation on time spent on the anagram task were again tested using hierarchical multiple regression analysis. The effect of the hypothesised predictor variables on time spent on the figure-tracing task was not significant ($R^2 = .14, p = .10$), $F(6, 72) = 1.85, p = .10$. Explicitly measured enjoyment from the IMI scale significantly predicted time spent on the anagram task ($\beta = .33, p = .02$). Furthermore, controlled motivation, measured by the GCOS scale provided significant prediction ($\beta = .30, p = .02$), providing support for hypothesis (H_1). In the second step, there was a significant change in R^2($\Delta R^2 = .09, p = .01$), $F(7, 72) = 2.90, p = .01$. IMI enjoyment ($\beta = .30, p = .03$) and the controlled subscale of GCOS ($\beta = .31, p = .01$) were still significant; however, implicitly measured motivation also provided significant prediction of time spent on the anagram task ($\beta = .31, p = .01$), supporting hypothesis (H_2). Testing the interaction effects using moderated hierarchical multiple regression (Aiken & West, 1991) revealed no significant effects for the IAT with any of the explicit measures on time spent completing the anagrams. This led us to reject our hypothesis (H_3) relating to the multiplicative model.

Study3.2 Discussion

The aim of Study 2 was to replicate the findings of Study 1. Furthermore, we used a solvable series of anagrams as the dependent behavioural measure in the present study in place of the unsolvable task used in Study 1 to allay any problems due to low perceptions of competence. Results indicated that the implicit measure of motivation significantly predicted time spent on the

anagram task consistent with hypotheses and results of Study 3.1. Furthermore, the enjoyment scale from the IMI also predicted behaviour, consistent with our hypothesis and the findings of Study 3.1. Finally, controlled motivational orientation from the GCOS significantly predicted persistence. The relative contribution of individuals' causality orientations over actions may vary across contexts, such that in some conditions environmental contingencies assume the upper hand in defining the quality of motivation experienced, but causality orientations 'win over' in others. Therefore, individuals with a predominantly controlled causality orientation are still able to experience intrinsic motivation (e.g., enjoyment) in their performance if the context provides sufficient opportunity to experience the action as being autonomous and choiceful, as satisfaction of the need for autonomy is necessary for intrinsic motivation (Hagger & Chatzisarantis, 2011).

A potential limitation of using anagram tasks is that their difficulty cannot be held constant for all participants. Some participants may find some of the anagrams easier than others. To limit this potential limitation, time-taken to complete the task was used as the outcome variable (rather than total completed). Furthermore, anagrams of varying difficulty, in terms of word length and word difficulty (e.g., frequency) were deliberately created. Feedback from participants in the pilot testing stages showed that no participants found all anagrams too difficult; however, no participants completed all anagrams. Overall, no participants completed all of the anagrams; therefore, no participants stopped short of the time limit due to successful completion. Furthermore, in contrast to Levesque and Pelletier (2003), who used crosswords, anagrams can be worked on over time.

Crossword clues may result in participants deciding they do not know and simply moving onto the next clue – therefore, there is a risk participants stop as they cannot complete anymore; this was not an issue with the anagram tasks. However, the issue remains that participants' levels of ability may affect time spent at the task. Future research could measure participants' comprehension of language and general ability at word tasks (e.g., spelling, writing etc.).

General Discussion

The purpose of the present research was to investigate the suitability of a dual-systems model (see Strack & Deutsch, 2004) as a framework for investigating the effects of implicit and explicit measures of autonomous motivation on task persistence in a free-choice paradigm. A series of hypotheses, based on previous research, were developed and systematically tested across both studies. The first hypothesis (H_1) proposed that explicit measures would provide significant prediction of behaviour. This hypothesis was mostly supported in both studies. A second hypothesis (H_2) was that the implicit measure of autonomous motivation would provide a unique and significant prediction of behaviour. This hypothesis was supported in both studies. A final hypothesis (H_3) concerned the possible interaction between implicit and explicit measures of autonomous motivation in the prediction of time spent on the tasks. Support for this hypothesis was not found in either study.

The current research therefore provides further support for the unique effect of implicit processes in motivation (Brunstein & Schmitt, 2004). Furthermore, providing this support alongside explicit measures is also vital in elucidating the effects of both implicit and explicit processes on behaviour (McClelland, 1985). Both behaviours currently studied were relatively novel to participants in that no prior intention or planning to complete them existed. Therefore, the significant effect of the implicit measure of autonomy may support the proposed dissociation between implicit measures better predicting spontaneous, unplanned tasks, and explicit measures better predicting tasks and behaviours that are planned or prepared for in advance (e.g., packing a kit for a gym session and scheduling it into a daily routine) (Brunstein & Schmitt, 2004). To fully explore this, both types of behaviour would need to be investigated in a single study.

It should be noted that not all scales of the explicit measures provided a significant prediction of persistence. The enjoyment scale of the IMI provided consistent, significant prediction of behaviour. Task-specific competence, measured by the IMI, significantly and negatively predicted persistence in Study 1 alone, which may be due to the unsolvable nature of the task thwarting participants' competence. The controlled scale of the GCOS measure significantly predicted behaviour in Study 3.2 only. Participants with a controlled orientation, as measured by the GCOS, may have felt the context to be controlling enough to cause them to continue attempting the anagram puzzles. Though a free-choice paradigm was used, and a standardized set of instructions given (Baumeister et al., 1998), some participants may still have

felt a sense of internal or external pressure to complete all of the anagrams. The controlled dimensions of the GCOS measure may not have offered significant prediction in the first study as the figure-tracing task was novel to participants; therefore, they had no prior experience and expectations of their performance. Essentially, for the anagram task, participants were likely to have previous experience in completing them and so feel pressure to achieve solutions for all anagrams; this is unlikely to have been the case for a novel figure-tracing task.

Further analyses were conducted to investigate the differences in prediction across the first and second study. In these analyses, type of task (unsolvable vs. solvable) was dummy coded and entered into a multiple regression. Results indicated that there was a significant change in time spent at the task ($M = 2.41$, SD = .88, $p = .01$), depending on whether it was solvable or not. Significantly more time was spent on the task in Study 3.2 (solvable task). As there were a number of anagrams that participants could solve, the positive competence feedback could have motivated them to continue. Future research should be vigilant that the type of task does not bias results.

Although a multiplicative model was not supported by the current data, the findings are still consistent with particular pattern of effects derived from Strack and Deutsch's (2004) RIM and Perugini's (2005) additive model. The RIM outlines the unique routes and effects of the reflective and impulsive system and the unique effects shown in the current studies are consistent with the unique routes offered in the model. An interesting and unexpected finding

in the present study was the significant and negative effect of explicitly-measured perceived competence in Study 3.1, but not in Study 3.2. This was attributed to the adoption of an unsolvable task. We selected this task as it would provide a relatively conservative estimate of the propensity of individuals to persist with task. This is because participants would have to overcome the challenge and difficulty when faced with continual failure on the task. However, it did have the likely adverse effect of inducing a sense of low competence in individuals the longer they persistence, such that the longer they spent on tasks the more incompetent they felt. This did not overall affect the pattern of effects for the implicit and explicit forms of autonomous motivation on behavioural persistence. Furthermore, this is consistent with the proposal by Ryan and Deci (2000) that individuals can be autonomously motivated to act and persist with tasks even if they feel incompetent. Consistent with this explanation, when we adopted a solvable dependent task in the second study, a similar pattern of results emerged in all but the competence ratings. Therefore, the nature of task being solvable or not did not affect the predictive validity of the implicit measure of autonomous motivation.

Research into self-determination theory (SDT) has largely adopted an explicit approach (Deci, Koestner, & Ryan, 1999; Hagger & Chatzisarantis, 2008). The current research offers an important contribution in showing, and replicating, the unique effects of implicit autonomous motivation on behaviour. This supports a growing trend in the literature as a whole, outlining the role of implicit processes in behaviour (Ahern, Bennett, & Hetherington, 2008; Back et al., 2009; Conner et al., 2007; Conroy, Hyde, Doerksen, &

Ribeiro, *2010*). An additive model of implicit and explicit motivational processes is further supported by the current research. This does not refute nor diminish SDT as a theory of motivation; moreover, it suggests that key premises of SDT also apply to implicit processes.

Conclusion

The current research provides support for a dual-systems model as a framework for understanding the unique effects of implicit and explicit measures of autonomous and controlled motivation from self-determination theory on behavioural persistence. Support for the predictive validity of implicit and explicit measure of autonomous motivation was provided in two studies and corroborates the findings of previous studies. While the literature is replete with studies focusing on explicitly-measured motivational variables and dependent measures, the current study makes an important contribution in adding support for the role of implicit motivational processes on goal-directed behaviour. Studies examining the factors influencing motivated behaviour from an SDT perspective should seek to incorporate both implicit and explicit measures of autonomous motivation in order to tap the full gamete of motivational influences. Future studies may also investigate the effect of manipulating implicit measures of autonomous motivation, perhaps using priming methods in order to further validate the effects of implicit measures of autonomous motivation on behaviour.

Chapter 5

The Predictive Validity of Implicit and Explicit Measures of Autonomous Motivation on Students' Grades

Chapter 5: The Predictive Validity of Implicit and Explicit Measures of Autonomous Motivation on Students' Grades

Introduction

In addition to previous research indicating the role of implicit processes across a range of health behaviours and problem-solving behaviours (see previous Chapters), research has also consistently supported the role of motivation in predicting students' performance in academic contexts (Alonso-Tapia & Pardo, 2006; Deci, Ryan, & Joshua, 2002; Niemiec & Ryan, 2009; Ryan & Deci, 2000a). Research examining the motivational antecedents of individuals' goal-directed behaviour has traditionally focused on deliberative, reflective decision making (Chatzisarantis & Hagger, 2009; Fishbein & Ajzen, 2009; Keatley et al., 2012; Orbell, Hagger, Brown, & Tidy, 2006). This approach assesses motivation through the use of self-report measures and assumes behavioural engagement is a deliberative, conscious process. As students frequently use methods to plan their work (e.g., diaries) the explicit approach of measuring their motivation has provided insight into students' achievement.

As deliberative theories lack an account of more spontaneous, or automatic processes, there has been a need to develop measures that assess implicit processes across a range of behaviours (Banting et al., 2009; Levesque et al., 2008), including education (Burton et al., 2006). These developments have been applied to areas of motivation, including self-determination theory (Deci & Ryan, 2008), a comprehensive theory of human motivation that has been repeatedly shown to offer a good account of the factors underlying

student achievement in educational settings (Niemiec & Ryan, 2009; Ryan & Deci, 2000a; Ryan, Deci, Carol, & Judith, 2000). The addition of implicit motivation, generally defined as non-conscious or automatic motivation, can be accounted for by dual-systems models of behaviour (e.g., Strack & Deutsch, 2004). Strack and Deutsch's reflective-impulsive model (RIM) is a dual-systems model has been proposed to account for the unique and combined effects of explicit and implicit processes on behaviour.

The choice to focus on academic achievement was made in order to investigate whether the students' motivation measured implicitly with the IAT showed similar predictive validity results to motivation measured implicitly with a lexical decision task (see Burton et al., 2006). The choice of actual subjects within Psychology was a corollary of the structure of the course at the University in which the study was being conducted; however, this is why individuals' module results and overall results are provided in this Chapter.

The aim of the current research was to investigate the effectiveness of implicit and explicit measures of motivation from self-determination theory in the prediction of University students' first-year grades. More importantly, this is the first study, to the authors' knowledge, that provides a direct test of dual-systems models for motivation in an educational setting. As outlined, previous research has demonstrated the facilitating effect of autonomous forms of motivation on academic performance, and the role of implicit autonomous forms of motivation on educational achievement; however, the current study offers a unique contribution to the literature by offering a comprehensive test of a dual-systems model to predict an objective behaviour-related outcome (grades) from the perspective of SDT.

The aim of the current research was to investigate the predictive validity of implicit and explicit measures of motivation from self-determination theory in the prediction of first-year undergraduate degree performance. A dual-systems model was adopted to provide a conceptual framework for the independent effects of implicit and explicit motivational processes in the prediction of students' academic achievement. Students' end-of-year grades across core Psychology courses (Psychology of Addiction, Biological Psychology, Cognitive Psychology, Developmental Psychology, Practical Methods, Statistical Methods, and Social Psychology) were the outcome variables, taken as an indicator of motivated behaviour (i.e., academic performance should be an indicator of persisting for longer with studying). From this framework, several hypotheses were formulated. First (H_1), we predicted that the implicit measure of autonomous motivation would provide unique prediction of behaviour, independent of explicit measures of motivation. This hypothesis is consistent with previous research in the area, which highlights the direct effect of implicit processes on behaviour (Czopp et al., 2004; Keatley et al., 2012). How much time a student chooses to revise, or study for each course is likely to be underpinned by both impulsive and reflective processes (Burton et al., 2006); therefore, it is predicted that implicit measures should show some significant prediction of all topics. However, the Practical Methods class (MPR) is assessed solely through coursework. Time to complete this coursework must be planned for and maintained; therefore, of all the outcome variables, this course may be the least well predicted by implicit measures of motivation. Second, we hypothesised (H_2) that explicit measures

of motivation[10] would provide unique prediction of behavioural engagement. This is consistent with previous research that supports the predictive validity of explicit measures of autonomous and controlled motivation across various behaviours (Burton et al., 2006; Hagger et al., 2006a). Testing the effects of both implicit and explicit measures of motivation on academic achievement (final grades) provides a test of the reflective and impulsive systems of the RIM. Students' academic success can be broken down into time spent revising for exams, completion of coursework, and time spent studying throughout the year. Therefore, these three main areas were all tested in the current research.

Method

Participants

Undergraduate students (N = 73; 62 female, 13 male, M_{age} = 19.41, range: 18-22 years) from the University of Nottingham participated in the current study. Students were approached during a practical class module with details of the study and the opportunity to participate. There was a £4 inconvenience allowance allocated for participation. The study protocol was approved by the School of Psychology Ethics Committee at the University.

[10] The general causality orientations scales (Deci & Ryan, 1985) were included in the research as they provide an explicit measure of individuals generalised motivation orientations. However, based on previous research (Keatley et al., in press-b), it is not clear whether they would have efficacy in predicting grades. Therefore, H2 applies to context-specific explicit motivation, measured with the perceived locus of causality scales.

Measures

Implicit Association Test (IAT). The IAT provides an implicit measure of individuals' autonomous and controlled motivation. Words representing autonomous (*choice, free, spontaneous, willing, authentic*) and controlled (*pressured, restricted, forced, should, controlled*) forms of motivation were taken from research conducted by Levesque and Brown (2007). In addition, to attain individuals' personal association with either motivational orientation, words relating to 'self' (*I, me, my, mine, self*) and 'others' (*others, they, them, their, theirs*) were also taken from Levesque and Brown. The category 'others' was fully explained and introduced as being 'not-self', rather than a social comparative category. Furthermore, the label 'others', was deemed more easily distinguished from 'self' than 'non-self' from 'self' (Brunstein & Schmitt, 2004). A standard five-step IAT was used. Blocks 1, 2, and 4 were for practice, each consisting of 20 trials; test blocks (3 and 5) comprised 60 trials – 20 practice and 40 test. The IAT effect was calculated using the improved *D*-score algorithm (Greenwald et al., 2003). Coding was such that higher scores were indicative of an autonomous motivation orientation.

Perceived locus of causality (PLOC). Explicit autonomous motivation from self-determination theory was measured using an adapted version of Ryan and Connell's (1989) perceived locus of causality (PLOC) scale at the first wave of data collection. Participants were given a common stem for each behaviour (e.g., "I study/revise for exams/complete coursework because..."). Participants were then asked a series of reasons, relating to the various forms of motivation from self-determination theory (e.g., autonomous: "I enjoy studying/revising

for exams/completing coursework"; controlled: "I will feel guilty if I do not study/revise for exams/complete coursework"). These were measured on a 4-point Likert-type scale ranging from *not true at all* (1) to *very true* (4).

Weighted composite items representing separate autonomous and controlled indices from the PLOC scales for each behaviour were then calculated (e.g., Guay et al., 2003; Hagger et al., 2006a). To calculate autonomous items, the sum of a randomly-selected intrinsic motivation item, weighted by a factor of two, was added to the score for a randomly-selected identified regulation item. This was repeated for the remaining intrinsic and identified regulation items, resulting in items representing explicit autonomous motivation. This process was repeated for items from the PLOC scales representing controlled forms of motivation. The sum of a randomly-selected external regulation item, weighted by a factor of two, and a randomly selected introjected regulation item was computed. This was repeated for the remaining external and introjected regulation items to produce items representing explicit controlled motivation.

General Causality Orientations Scale (GCOS). The GCOS was used to assess individuals' relatively enduring autonomous and controlled motivational orientations from SDT. The scale comprised 12 vignettes depicting social or achievement situations. Each vignette was then followed by statements distinguishing between autonomous and controlled orientations. Responses were made on a seven-point Likert-type scale, ranging from *very unlikely* (1) to *very likely* (7).

Academic Achievement. This was assessed by using students' transcripts, collected at the end of the year. Transcripts provided marks for each course (Psychology of Addiction, Biological Psychology, Cognitive Psychology, Developmental Psychology, Practical Methods, Statistical Methods, and Social Psychology) taken, as well as an overall grade. Grades are given in numerical format, and no transformation was necessary. Practical Methods in Psychology (MPR) is a coursework-only course without a final exam, so an overall grade was also calculated (Overall-MPR) excluding the score for this course. All other courses contained a coursework element and examination.

Procedure

Participants were tested at the beginning of the academic year. They were informed that the study was looking at the factors influencing final grade outcomes, and their end-of-year marks would be accessed. After providing informed consent, participants were asked to follow instructions and complete the IAT. Once all participants had completed the IAT, they were given questionnaires, which they completed and returned to the researcher. The entire process took approximately 15 minutes. At the end of the school year, grades were collected.

Results

Preliminary analyses

All participants' IAT data had less than 10% of scores below 300ms, and no values exceeded 10,000ms. Therefore, none of the participants was eliminated because they failed to meet improved scoring algorithm criteria (Greenwald et al., 2003). IAT-*D* scores were calculated such that higher scores were indicative of a higher level of implicit autonomous motivational orientation.

For all descriptive statistics, see Table 8. Zero-order correlations provided an initial indication of the pattern of relationships among implicit and explicit measures of motivation, course grades, and the overall outcome grade (see Table 9). The IAT-*D* score was significantly correlated with students' overall outcome grade ($r = .34, p < .001$), and several courses: Psychology of Addiction ($r = .36, p < .001$), Biological Psychology ($r = .33, p < .001$); Cognitive Psychology ($r = .30, p < .001$); and Statistical Methods ($r = .32, p < .001$). Of the explicit measures of motivation, introjected motivation to revise and study were significantly correlated with academic achievement in every course and overall grade.

Table 8. Summary of Descriptive Statistics

	Descriptives		
	Alpha (MIC)	Mean	SD
1. IAT D	.52	5.40	1.42
2. CworkIM	.74 (.59)	2.50	.67
3. CworkID	.64 (.47)	3.43	.49
4. CworkIJ	.62 (.45)	3.15	.60
5. CworkER	.52 (.35)	2.75	.60
6. ReviseIM	.65 (.49)	1.61	.65
7. ReviseID	.50 (.33)	3.51	.47
8. ReviseIJ	.72 (.57)	3.27	.66
9. ReviseER	.54 (.37)	2.80	.69
10. Study IM	.62	2.11	.68
11. Study ID	.61	3.22	.47
12. Study IJ	.71	2.73	.57
13. Study ER	.58	2.12	.60
14. GCOSa	.71	5.49	.69
15. GCOSc	.68	4.32	.54
16. OverAll		60.65	5.64
17. Overall -MPR		60.56	8.30
18. ADD		55.13	11.286
19. BIO		61.21	8.806
20. COG		62.16	9.652
21. DEV		64.97	8.402
22. MPR		61.23	6.789
23. MST		61.21	11.242
24. SOC		58.49	9.244

Note. IAT D = Implicit Association Test IAT D-score; Variables 2-13 are items from perceived locus of causality; CworkIM = intrinsic motivation for coursework; CworkID = identified regulation for coursework; CworkIJ = introjected regulation for coursework; CworkER = extrinsic regulation for coursework; ReviseIM = intrinsic motivation for revision; ReviseID = identified regulation for revision; ReviseIJ = introjected regulation for revision; ReviseER = extrinsic regulation for revision; GCOSa = general causality orientations scale autonomy; GCOSc = general causality orientations scale, controlled; OverAll = Overall grade for the year, including MPR; Overall-MPR = Overall grade for the year minus MPR module results; ADD = Psychology of Addiction; BIO = Introduction to Cognitive Neuroscience and Biological Psychology; COG = Cognitive Psychology; DEV = Introduction to Developmental Psychology; MPR = Practical Methods in Psychology; MST = Statistical Methods; SOC = Introduction to Social Psychology; MIC = mean inter-item correlations

* $p < .05$. ** $p < .01$

Table 9. Summary of intercorrelations for Study Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. IAT D	-																							
2. CworkIM	.10	-																						
3. CworkID	.08	.15	-																					
4. CworkIJ	.18	.29*	.44**	-																				
5. CworkER	-.02	.13	.29*	.42**	-																			
6. ReviseIM	.10	.34**	-.03	.04	-.01	-																		
7. ReviseID	.13	.02	.41**	.29*	.21	.06	-																	
8. ReviseIJ	.24*	.24*	.24*	.73**	.26*	.06	.34**	-																
9. ReviseER	-.17	-.03	.14	.15	.63**	.11	.12	.05	-															
10. Study IM	.12	.46**	.27*	.30*	.02	.34**	.29*	.26*	.16	-														
11. Study ID	.20	.19	.45**	.37**	.23*	.31**	.48**	.37**	.17	.47**	-													
12. Study IJ	.10	.13	.40**	.61**	.39**	.13	.44**	.64**	.18	.22	.51**	-												
13. Study ER	-.09	.03	.28*	.34**	.241*	.09	.05	.21	.08	.01	.21	.46**	-											
14. GCOSa	-.03	-.14	.29*	.10	.11	-.12	.45**	.29*	.17	.01	.37**	.33**	.09	-										
15. GCOSc	-.02	.28*	.15	.03	.37**	.12	.24*	.02	.38**	.05	.28*	.12	-.07	.28*	-									
16. OverAll	.34**	.04	.03	.24*	.19	.10	.25*	.36**	.02	.23	.21	.41**	.01	.12	-.02	-								
17. Overall -MPR	.34**	.04	.03	.23*	.19	.12	.25*	.35**	.02	.22	.21	.41**	.01	.10	-.01	.99**	-							
18. ADD	.36**	.00	-.01	.15	.03	.13	.22	.39**	-.11	.24*	.24*	.32**	-.04	.17	.02	.83**	.85**	-						
19. BIO	.33**	.07	.08	.21	.05	.16	.22	.30*	-.08	.22	.23*	.31**	-.08	.03	.00	.87**	.88**	.77**	-					
20. COG	.30*	.08	.04	.25*	.21	.13	.20	.28*	.09	.20	.17	.40**	.08	.10	-.02	.87**	.86**	.59**	.70**	-				
21. DEV	.21	.01	.11	.23	.21	.14	.18	.25*	.05	.14	.17	.46**	.14	.07	-.05	.82**	.82**	.64**	.68**	.66**	-			
22. MPR	.22	.02	.02	.24*	.12	-	-	-	-	-	-	-	-	.22	-.10	.72**	.65**	.49**	.53**	.64**	.52**	-		
23. MST	.32**	-.04	-.01	.20	.21	.06	.22	.30*	.01	.12	.11	.30*	.08	.05	-.02	.86**	.86**	.65**	.70**	.69**	.64**	.59**	-	
24. SOC	.21	.14	-.05	.17	.22	.02	.20	.29*	.11	.19	.16	.35**	-.11	.08	.01	.82**	.83**	.63**	.65**	.72**	.60**	.57**	.61**	-

Note. IAT D = Implicit Association Test IAT D-score; Variables 2-13 are items from perceived locus of causality; CworkIM = intrinsic motivation for coursework; CworkID = identified regulation for coursework; CworkIJ = introjected regulation for coursework; CworkER = extrinsic regulation for coursework; ReviseIM = intrinsic motivation for revision; ReviseID = identified regulation for revision; ReviseIJ = introjected regulation for revision; ReviseER = extrinsic regulation for revision; GCOSa = general causality orientations scale autonomy; GCOSc = general causality orientations scale, controlled; OverAll = Overall grade for the year, including MPR; Overall-MPR = Overall grade for the year minus MPR module results; ADD = Psychology of Addiction; BIO = Introduction to Cognitive Neuroscience and Biological Psychology; COG = Cognitive Psychology; DEV = Introduction to Developmental Psychology; MPR = Practical Methods in Psychology; MST = Statistical Methods; SOC = Introduction to Social Psychology;

* $p < .05$. ** $p < .01$

Table 10. Multiple Regression Analyses Predicting Module Outcome Grades and Overall Grade From Implicit and Explicit measures of Motivation and General Causality Orientations

Module	Coursework								Revision for exams								Study throughout the year							
	IATD	IM	ID	IJ	ER	GCOS a	GCOS c	R^2	IATD	IM	ID	IJ	ER	GCOS a	GCOS c	R^2	IATD	IM	ID	IJ	ER	GCOS a	GCOS c	R^2
ADD	.36 **	-.03	-.14	.18	-.04	.23	-.04	.19	.27*	.08	.04	.30*	-.14	.12	-.03	.27	.32 *	.17	-.08	.34*	-.20	.15	-.09	.28
BIO	.30*	.002	-.03	.17	-.01	.03	.01	.13	.23+	.12	.15	.21	-.07	-.07	-.002	.19	.25*	.09	.04	.39*	-.24	-.07	-.05	.24
COG	.29*	.08	-.15	.13	.23	.17	-.15	.19	.26*	.10	.09	.17	.14	.04	-.12	.17	.26 *	.15	-.16	.45*	-.08	.04	-.05	.26
DEV	.20	-.02	-.01	.22	.08	.08	-.14	.12	.16	.12	.11	.17	.09	.01	-.12	.12	.16	.06	-.12	.55**	-.08	-.04	-.07	.26
MPR	.21+	.06	-.18	.18	.14	.31*	-.22+	.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MST	.32*	-.08	-.16	.14	.23	.08	-.07	.19	.26*	.01	.14	.20	.06	-.05	-.06	.17	.31*	.08	-.16	.33*	-.02	.02	-.02	.19
SOC	.21+	.16	-.22	.06	.28+	.18	-.15	.16	.17	-.03	.11	.23+	.15	-.04	-.05	.14	.14	.11	-.11	.51*	-.31*	-.01	-.04	.24
Overall	.33*	.02	-.16	.15	.20	.18	-.12	.21	.27*	.05	.13	.24+	.07	.02	-.09	.22	.28*	.14	-.12	.48*	-.17	.05	-.07	.31
Overall -MPR	.33*	.02	-.15	.14	.20	.15	-.10	.20	.27*	.07	.14	.24*	.06	-.01	-.07	.22	.28*	.13	-.11	.49*	-.17	.02	-.05	.30

Note. ADD = Psychology of Addiction; BIO = Introduction to Cognitive Neuroscience and Biological Psychology; COG = Cognitive Psychology; DEV = Introduction to Developmental Psychology; MPR = Practical Methods in Psychology; MST = Statistical Methods; SOC = Introduction to Social Psychology; Overall = Overall grade for the year, including MPR; OverallMPR = Overall grade for the year minus MPR module results; Medians = Median betas for each predictor; IATD = Implicit Association Test IAT D-score; IM = explicitly measured intrinsic motivation; ID = explicitly measured identified regulation; IJ = explicitly measured introjected regulation; ER = explicitly measured extrinsic regulation; GCOSa = explicitly measured autonomous general causality orientation; GCOSc = explicitly measured controlled general causality orientation.

$^{+} = p < .10$; $^{*} = p < .05$; $^{**} = p < .001$.

Predicting Behaviour

Linear regression analyses were conducted to investigate the predictive validity of implicit and explicit measures of motivation on academic achievement. Students' implicit and explicit motivation for completing coursework, revising, and studying throughout the year were tested in separate linear regression models. In each linear regression, IAT, GCOS and PLOC relating to the either coursework completion, revision, or study throughout the year were included as predictor variables. A separate regression model using averaged overall grade for each individual course in with the students were enrolled and the overall psychology programme for the academic year formed the dependent variables in each regression (See Table 9).

Overall Grade (excluding MPR). The pattern of effects was consistent between prediction of overall grade, and individual course prediction; therefore, overall grade is reported here. As the Practical Methods in Psychology course is entirely coursework based, this is reported separately. For coursework completion, the effect of the predictor variables was significant, ($R^2 = .20, p < .05$), $F(5, 72) = 2.24, p = .04$. The implicit measure of motivation was a significant predictor ($\beta = .33, p = .01$), which supports our hypothesis (H_1). None of the explicit measures of motivation was significant, which led us to reject our second hypothesis (H_2). For revision for exams, the model was significant ($R^2 = .22, p < .05$), $F(7, 72) = 2.60, p = .02$. The implicit measure was a significant predictor of grades ($\beta = .27, p = .03$) supporting H_1 as was explicitly-measured introjected motivation ($\beta = .24, p = .05$), lending

support for H_2. For study throughout the year, the model was significant (R^2 = .30, $p < .001$), $F(7, 72) = 4.03$, $p < .001$. The implicit measure of motivation was again a significant predictor ($\beta = .28$, $p = .01$), supporting the first hypothesis (H_1), as was explicitly measured introjected motivation ($\beta = .49$, $p < .001$), supporting hypothesis (H_2).

Practical Methods in Psychology (MPR). The model for coursework completion was significant ($R^2 = .20$, $p < .05$), $F(7, 72) = 2.23$, $p = .04$. Implicitly measured motivation was not a significant predictor ($\beta = .21$, $p = .07$), failing to supporting hypothesis (H1). Only the GCOS-autonomy explicit measure was a significant predictor ($\beta = .31$, $p = .02$), partially supporting our second hypothesis (H_2). As there were no exams for this course, revision for exams and study throughout the year were excluded.

Discussion

The aim of the current research was to investigate the independent roles of implicitly- and explicitly-measured motivation from self-determination theory in the prediction of academic achievement, using a dual-systems model (Strack & Deutsch, 2004) as a framework. Based on previous research in the area, hypotheses were developed and tested across each course in an undergraduate psychology degree programme, as well as overall end-of-year grade.

Our first hypothesis (H_1) was that an implicit measure of motivation from self-determination theory would uniquely predict academic achievement independent of explicit measures of self-determined motivation. Across the courses of the degree programme, the implicit measure of self-determined motivation significantly predicted participants' overall grades. For coursework completion and revision for exams, explicit measures of motivation provided relatively few significant effects; however, for studying throughout the year explicitly-measured introjected motivation provided consistent significant prediction for all modules and overall grade outcome, which supports our second hypothesis (H_2).

The implicit measure of motivation did not significantly predict the Practical methods (MPR) grades; however, did predict several of the other courses. This may be due to the different way in which MPR is assessed, through coursework. While all of the other courses contain coursework, the main weighting of the marks are taken from examinations. Exam marks are influenced by study throughout the year and revision for exams, both of which are more likely to have elements of spontaneity (e.g., unplanned free-time being used to read extra work, or study an extra hour etc.). Therefore, an explanation for why MPR was not predicted by the implicit measure while the other behaviours were may be due to the way the courses are assessed and whether implicit processes exert an influence.

In relation to self-determination theory (SDT), the current research adds to a growing trend indicating the important role of implicit processes on behaviour (Ahern et al., 2008; Conner et al., 2007). Research into SDT has traditionally adopted an explicit approach to the measuring motivational constructs (Hagger & Chatzisarantis, 2008); however, it is becoming increasingly apparent that the inclusion of implicit measures of motivation are required to provide a more complete account of the motivation antecedents of behaviour.

One explanation for why implicitly-measured motivation may not predict performance in the practical classes may lie in structure of the assessment for this module. Students submit laboratory reports every two weeks and knew they would have reports to write; therefore, they would have had to plan time in their week to complete the assignment. The lack of predictive validity of explicit measures of motivation for completion of laboratory practical coursework is a limitation that requires further investigation. Given that an explicit measure focusing on coursework completion was included in the questionnaire, it is not clear why this did not provide significant prediction.

The current research provides some support for the RIM (Strack & Deutsch, 2004). Across the majority of the courses, implicitly-measured motivation provided significant prediction of academic achievement. In contrast, explicitly-measured motivation did not provide significant prediction

for coursework completion or revision for exams. This difference between explicitly and implicitly-measured motivation supports the unique effect of implicit processes on behaviour. For study throughout the year, explicitly measured introjected motivation provided significant prediction for all of the courses, alongside implicitly-measured motivation. Burton and colleagues (2006) found that identified motivation significantly predicted academic performance. The current findings are therefore inconsistent with Burton and colleagues. However, identified and introjected motivation are often correlated; therefore, patterns of prediction may vary as a result. The RIM can be used to provide a parsimonious account of this. Students may feel the desire to study throughout the year to attain positive internal states (e.g., self-esteem, well-being), and enact that desire automatically when an opportunity arises. The two motivation types may have independent effects in terms of having a general explicit desire to study in order to feel good and using spontaneous or unplanned opportunities to attain this state.

Conclusion

Overall, the two main predictors of academic achievement in the current paper were implicitly-measured motivation, and explicitly-measured introjected motivation. As outlined, these motivation types can act synergistically to in motivating study throughout the year. Students' well-being and internal states, such as self-esteem, should therefore be taken into account when providing feedback, especially criticism. In terms of practical recommendations, unplanned opportunities for extra study may provide further chances for students to enact their motivation to study. An alternative option

would be to create a habitual, or routine session in which students' involvement becomes an automatic process, therefore relying more on the implicit system.

Chapter 6

Effects of pretesting implicit Self-Determined Motivation on Goal-Directed Behaviour: Evidence for the Mere Measurement Effect at the Implicit Level

Chapter 6: Effects of pretesting implicit Self-Determined Motivation on Goal-Directed Behaviour: Evidence for the Mere Measurement Effect at the Implicit Level

Introduction

The final study in the current thesis focused on a different aspect of implicit measurement of motivation orientations. While previous chapters focused on the predictive validity of implicit measures of motivation from SDT; a further issue related to implicit measurement in general is whether completion of the measure affects subsequent behaviour. When considering explicit assessments of motivation and other psychological constructs, recent research has shown that completion of a questionnaire containing measures significantly affects subsequent behaviour, frequently referred to as the *mere measurement* effect (Conner et al., 2011; Godin et al., 2010). While a mere measurement effect has been observed for explicit measures, an important outstanding question is whether the mere measurement effect generalizes to implicit measures. In the current study, a Solomon four-group design (Solomon, 1949) was used to investigate this hypothesis. The hypothesis that the mere completion of an implicit measure of motivation from self-determination theory is sufficient to affect people's behavioural responses was tested. However, completion of measures may also interact with the provision of information in the environment aimed at enhancing or diminishing self-determined forms of motivation such that mere measurement would have the effect of sensitizing an individual to the information and enhance its impact on behaviour. There is evidence that measuring a trait may influence how a person then responds in follow-up behaviours following an intervention (Braver &

Braver, 1988; McCambridge, Butor-Bhavsar, Witton, & Elbourne, 2011; Solomon, 1949). Thus, measurement can influence the effect on experimental interventions.

Within the realm of implicit process this would be akin to suggesting that the measurement of an implicit cognition would sensitize that person's responsivity to a subsequent implicit manipulation of information (e.g., priming) and this would be observed on subsequent behaviour. In terms of the mechanisms behind the sensitising effect, it is hypothesized that the implicit measure will activate the mental structures associated with the primed construct, prior to priming itself. The implicit measure would, therefore, serve as an initial prime itself. The aim of the present research was to investigate the effects of implicitly-measured motivational orientations, and the priming of these factors, on behavioural engagement. The current research adopts a theoretical approach and measures from self-determination theory (Deci & Ryan, 1985).

Self-determination theory

Self-determination theory (SDT) is a broad theoretical paradigm that has been applied extensively to the study of motivated behavior (Deci & Ryan, 2008; Edmunds et al., 2007). A key premise of the theory is that individuals who experience a behavior as autonomous or self-determined will be more likely to persist at an activity without the need for an external contingency or reinforcement. Furthermore, autonomously-motivated individuals typically experience associated feelings of interest, enjoyment, or inherent satisfaction when performing a behaviour. In contrast, individuals engaging in an activity in order to gain externally-referenced outcomes are considered to be motivated

by more controlled or extrinsic reasons. These individuals perform an activity out of a sense of pressure or obligation, and are therefore less autonomous and more controlled. As individuals are not performing the behavior for autonomous reasons, they are more likely to cease the activity if the reinforcing contingency is removed.

Implicit measures of self-determined motivation

There is increasing research examining the effects of implicit measures of constructs from SDT on subsequent behavioural outcomes (Banting, Dimmock, & Lay, 2009; Burton, Lydon, D'Alessandro, & Koestner, 2006; Levesque & Brown, 2007; Levesque, Copeland, & Sutcliffe, 2008). The benefits of augmenting SDT with implicit processes and measures have been shown in several studies (Levesque & Brown, 2007; Levesque et al., 2008). Previous research shows that implicit measures of motivation may provide better predictions for less goal-oriented, more spontaneous behaviours, while explicit measures provide better prediction for planned or deliberative behaviours (Keatley, Clarke, & Hagger, 2011; Perugini, Prestwich, & O'Gorman, 2007). In addition, implicit measures of motivation from the SDT perspective have been shown to reflect more generalized and enduring, as opposed to specific and changeable, motivational orientations (Keatley et al., 2012; Keatley, Clarke, & Hagger, in press-a). However, there is no research that has examined whether the measurement of implicit measures of motivation from SDT affects subsequent behavioural engagement: a mere measurement effect for implicit measures.

Priming motivation from self-determination theory

An additional factor warranting investigation when considering the effects of implicit motivational orientations from SDT on behaviour is the methods that have been used to alter or *change* the orientations and concomitant behavioural responses. Studies have demonstrated that implicit priming of motives from SDT can affect subsequent behavioural responses (Burton et al., 2006; Levesque & Pelletier, 2003; Ratelle et al., 2005). For example, Levesque and Pelletier (2003) administered a scrambled sentence task (Srull & Wyer, 1979), comprising target words linked to either autonomous or controlled motivation, to participants in order to prime motivational orientations from self-determination theory. Priming produced responses consistent with responses to explicitly-measured motivational orientations. Levesque and Pelletier's study provides an important contribution to the inception of the current research in terms of the effects of priming motivation. However, while they focused on explicitly-measured motivational orientations, the present research advances knowledge by exploring the effect of an implicit measure of motivation to moderate (sensitize) the effect of priming on subsequent behaviour.

Solomon four-group design

In order to better understand the main and interactive effects of implicit measurement and manipulation of motivation (primes) on subsequent behaviour, a Solomon's (1949) four-group design was used. There is considerable support for this design in terms of its internal and external validity and overall power as an experimental design to disentangle the effects of measure on behaviour (mere measurement effect) and sensitizing effects on

outcome variables (Braver & Braver, 1988). In the current research, the design requires the testing of four groups: (a) implicit measure and treatment; (b) implicit measure only; (c) treatment only; and (d) no implicit measure or treatment condition. The Solomon four-group is designed to test whether measurement of a construct confounds an intervention. That is, whether measuring a construct alters or complements the way people respond to a subsequent intervention. It is essentially a 2 x 2 design, except that one of the factors is a pre-test, not an independent variable, per se. In this case, the pre-testing sensitization is the measurement of implicit motivation using the IAT, and the intervention, which should be administered some time after the measurement, is the prime for either autonomous or controlled motivation, as these form the two main types of motivation in SDT. A recent large-scale systematic review supported the Solomon design and its usefulness to control for mere measurement in intervention designs (McCambridge et al., 2011). A further advantage of the Solomon design is that it allows for small sample sizes to be used, while not decreasing overall power (McCambridge et al., 2011; Mungas & Walters, 1979; Spence, Burgess, Rodgers, & Murray, 2009).

The Present Study

The aim of the present study was to test the possibility of a mere measurement effect with implicit measures of motivation. The IAT was used as it is a typical measure of implicit motivation (Keatley et al., 2012, in press-a), priming or autonomous or controlled motivation was used as the interventions, and the behavioural measure of motivation was the number of attempts made on a novel problem-solving task (see Baumeister et al., 1998; Moller et al., 2006). Participants' autonomy was not at risk of being

undermined as the problem-solving task was presented in a free-choice paradigm wherein participants could stop at any time (Hagger & Chatzisarantis, 2011).

In the current study, it is hypothesised that (H_1) the measurement of implicit motivation would lead to changes in behaviour (mere measurement effect); however, given that the measure is relative it is unclear in which direction behaviour will be changed; (H_2) the autonomous and controlled priming manipulation would increase and decrease number of attempts made, respectively; and (H_3) the interaction between prime type (autonomous vs. controlled vs. none) and implicit measure of motivation (present vs. absent) would result in the greatest behavioural change when both prime and measure are present (the sensitizing effect).

Method

Design

Initially, the research incorporated two Solomon four-group designs, one focusing on each priming manipulation (autonomous and controlled). However, for parsimony, these two were combined to form a 2 (IAT measure: present (N = 20) vs. absent (N = 20)) x 3 (Priming: autonomous (N = 10) vs. controlled (N = 10) vs. none (N = 20)) design. The outcome measure was number of attempts made on a figure-tracing task.

Participants

Undergraduate students (N = 80; 52 female, 28 male, *M* age = 20.50, age range: 19-46) from the University Nottingham participated in the study. Students were contacted via emails. A £4 inconvenience allowance was provided for participation. The ethics committee in the School of Psychology

at the University of Nottingham approved the study protocol. We combined data from two studies that were conducted separately, one focusing on primes for autonomous motivation and one focusing on primes for controlled motivation, in Solomon four-group designs. There were no demographic differences between experiment groups; therefore, they were combined for parsimony.

Measures and Experimental Manipulations

Implicit Association Test (IAT). A modified version of the IAT was used to measure implicit autonomous and controlled motivation. The underlying principle of the IAT is that the presentation of paired category and attribute stimuli that are strongly associated in memory (e.g., words like *self* and *autonomous*) will result in shorter response latencies compared to paired category and attribute stimuli that are weakly associated (e.g., words like *self* and *controlled*). Words representing autonomous (*choice, free, spontaneous, willing, authentic*) and controlled (*pressured, restricted, forced, should, controlled*) motivation and words pertaining to 'self' (*I, me, my, mine, self*) and 'others' (*others, they, them, their, theirs*) were taken from research conducted by Levesque and Brown (2007), in which they were shown to offer distinct representations. Further information was also provided explaining the differences between the motivation types. The category 'others' was fully explained and introduced as being 'not-self', rather than a more social-comparison category, and previous research has also incorporated these labels (e.g., Brunstein & Schmitt, 2004). A standard five-step IAT was used. Blocks 1, 2, and 4 were for practice, each consisting of 20 trials; test blocks (3 and 5) comprised 60 trials – 20 practice and 40 test. The IAT effect was calculated

using the improved *D*-score algorithm(Greenwald et al., 2003). Coding was such that higher scores were indicative of an autonomous motivation orientation relative to controlled motivation. No participants were eliminated due to having more than 10% of their IAT scores below 300 ms and no values exceeded 10,000 ms, which are restrictions imposed by the improved scoring algorithm for the IAT (Greenwald et al., 2003).

Priming of autonomous motivation. Autonomous motivation was primed using a scrambled sentence task (SST). Participants were presented with a series of 15 sentences in which the word order was scrambled. Participants were instructed to use four of the five words in each scrambled sentence to create a grammatically correct sentence. Based on previous findings (Levesque & Pelletier, 2003; Srull & Wyer, 1979), prime words were incorporated into 12 items (80%). Prime words were: *spontaneous*, *challenge*, *interested*, *volunteered*, *involved*, *satisfied*, *autonomous*, *mastering*, *delighted*, *absorbed*, *competent*, and *enjoying*. An example of the type of scrambled sentence is: "has challenge he a chair". Participants could create two grammatically-correct sentences; one that included the prime word and another that did not.

Priming of controlled motivation. For the priming controlled motivation condition, the key prime words included in the scrambled sentence task were: *competitive*, *obligation*, *expected*, *evaluated*, *constrained*, *demanded*, *avoiding*, *restricted*, *forced*, *pressured*, *controlled*, and *proving*. The words were again embedded in the scrambled sentences (e.g., "is quiet competitive very she"). The sentences were the same as the autonomous

priming condition; the only exception was that the autonomous motivation stimulus words were substituted for the controlled motivation words.

Outcome variable. Number of attempts on the figure-tracing task was the dependent variable as this allows for close comparison with Levesque and Pelletier's (2003) research that focused on number of solutions provided to a crossword puzzle.

Test of Awareness. As outlined in Chartrand and Bargh (1996), participants' awareness of the nature of the primes that they were exposed to was measured. At the end of the study, participants were asked (a) whether they had done the separate parts of the study as unrelated tasks and (b) whether anything they had done in the first sections affected what they had done in the experimental task (item recoded). These were answered on a 7-point Likert-type scale (1 = *do not agree at all*, 7 = *agree completely*).

Procedure

The study adopted a between-participants, Solomon (1949) four-group design. Participants were invited into the laboratory and tested individually. Participants received sufficient information for each section of the study and signed an informed consent form prior to data collection. Participants were randomly assigned to one of four experimental conditions. Depending on allocation, participants completed either: an IAT and an autonomy-related SST; the IAT alone; SST alone; or no pre-test measure or prime.

Once participants had completed their pre-test group condition, they were instructed to complete the figure-tracing task according to a protocol provided by Moller et al. (2006). Participants were required to trace several

geometric figures without taking their pencil from the page once they started, and without retracing any line once drawn. Participants were initially given two solvable figures to trace, in order to confirm they understood the rules and process. Multiple slips of paper were provided so that participants could make as many attempts as they wanted. After completion of the practice trials, the researcher administered the test figures. Participants were unaware that the test figures were unsolvable. The task has been used in numerous previous studies as a measure of behavioural persistence (Hagger, Wood, Stiff, & Chatzisarantis, 2010). The researcher then left the room, for the participants to attempt the task for as long as they wanted. A maximum of twenty minutes was set; any participants still working after this time were told to stop.

Results

Preliminary analysis

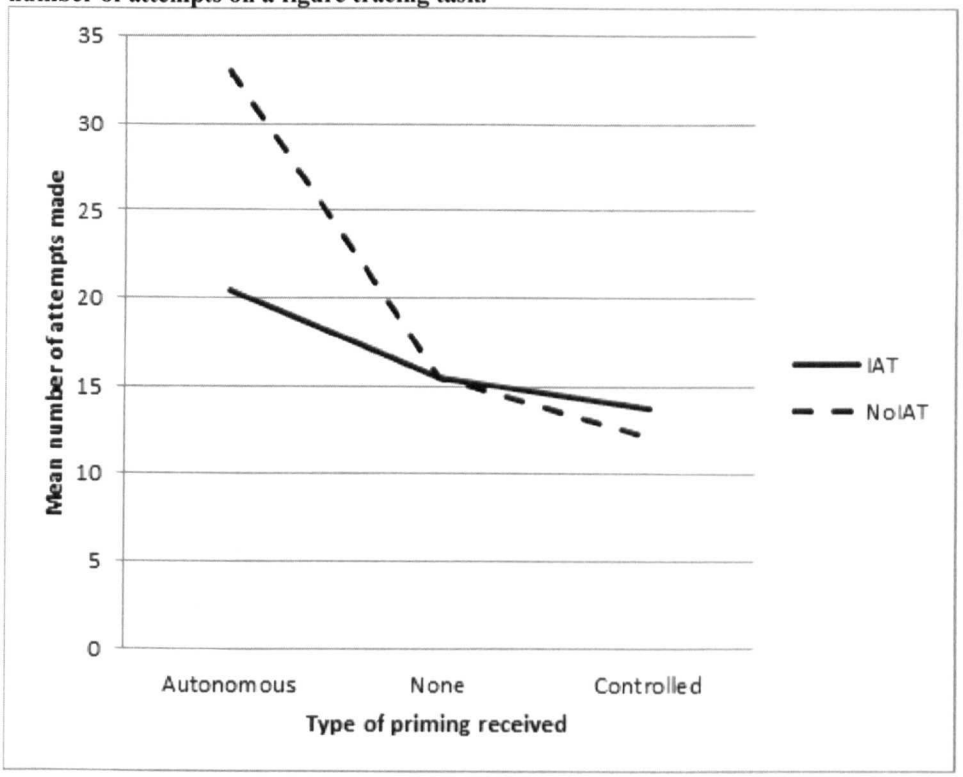
Awareness checks indicated that participants believed that the two parts of the study were unrelated ($M = 4.83$, SD = 0.83), and that completion of the experimental task was not affected by what they had previously done ($M = 6.04$, SD = 0.82). All participants in the scrambled sentence conditions indicated at least 4 (on a 7-point scale) on both awareness check questions. No participants reported any suspicion or awareness of the priming manipulation.

Effects of IAT and Primed Motivation

The effect of the measures and priming variables was examined with a 2 (IAT measure: present vs. absent) x 3 (Priming: autonomous motivation vs. controlled motivation vs. none) analysis of variance (ANOVA) with number of attempts made on the anagrams as a dependent variable. The ANOVA revealed

a significant main effect for the IAT, $F(1, 74) = 4.87$, $p = .03$, $\eta_p^2 = .06$, such that participants completing the IAT made fewer attempts on the figure-tracing

Figure 2. Graph showing the interaction of IAT completion and priming manipulation on number of attempts on a figure tracing task.



task (M = 16.25, SD = 7.75) than those that did not complete the IAT (M = 19.08, SD =10.65), indicating the presence of a mere measurement effect.

A significant main effect for the prime was also found, $F(2, 74)$ = 22.23, $p < .001$, $\eta_p^2 = .38$, indicating that participants that completed the prime for autonomous motivation made significantly more attempts (M = 26.75, SD = 10.12) than those that received the prime for controlled motivation (M = 12.90, SD = 5.79) and those that did not receive any priming manipulation (M = 15.50, SD = 7.22).

Finally, a significant IAT completion x priming interaction was observed, $F(2, 74) = 6.40$, $p = .01$, $\eta_p^2 = .15$ (see Figure 1). Analysis of simple main effects of all comparisons revealed a significant difference in number of

attempts on the anagrams in the no-IAT condition for those who received the autonomous motivation prime (M = 33.10, SD = 9.13) compared to those who did not receive the prime (M = 15.55, SD = 6.12), $F(1,56)=36.03$ $p < .001$, η_p^2 =.39. There was also a significant difference in attempts within the prime for autonomous motivation condition for those who did not receive the IAT (M = 33.10, SD = 9.13) and those that did (M = 20.40, SD = 6.72), $F(1,56)=14.15$, $p < .001$, η_p^2 =.20. Furthermore, there was a significant difference in number of attempts made in the no-IAT condition for those who received a prime for autonomous motivation (M = 33.10, SD = 9.13) compared to those who received a prime for controlled motivation (M = 12.10, SD = 5.38), $F(1,36)=44.54$, $p < .001$, η_p^2 =.55. There was a significant difference when the IAT was administered between those who then received a prime for autonomous motivation (M = 20.40, SD = 6.72) and those who then received a prime for controlled motivation (M = 13.70, SD = 6.36), $F(1,36)=16.29$, $p < .001$, η_p^2 =.31. These results indicate that completion of the IAT may affect subsequent priming manipulations, indicating the IAT may sensitize more controlled forms of motivation.

Discussion

There is an expanding literature that demonstrates that completion of explicit measures of motivation or other social psychological constructs has a significant effect on behaviour (Conner, Godin, Norman, & Sheeran, 2011; Godin et al., 2010)–the mere measurement effect. Research in the implicit domain has never systematically investigated this phenomenon. It was expected that completion of an implicit measure would affect subsequent

behaviour. The present study was the first to test the mere-measurement effect for implicit measures in the field of SDT and motivation. Results confirmed the hypothesis indicating that completion of implicit measures enhanced behaviour. A further hypothesis that priming autonomous motivation would significantly increase performance, and that priming controlled motivation would significantly decrease performance, in terms of the number of attempts made on the figure-tracing tasks was supported. This provides further evidence for the effectiveness of priming on behavioural engagement (Burton et al., 2006; Levesque & Pelletier, 2003; Ratelle et al., 2005).

The final hypothesis was to investigate the interaction effect of the implicit measure of motivation and the prime on behaviour. It was proposed that the implicit measure would 'senstize' individuals to the prime. This interaction was found and indicated that the prime for autonomous motivation led to increased attempts at a novel problem-solving task only when participants did not complete the implicit measure of motivation. This is very important in relation to future research adopting implicit measures of motivation from SDT, especially if this is followed by a behavioural outcome task. To speculate, it is possible that the implicit measure of motivation may sensitize individuals to 'controlled' motivation, regardless of how the IAT is scored.

In terms of self-determination theory (SDT), the current findings continue a growing trend in research indicating the important role of implicit processes on behaviour (Ahern et al., 2008; Conner et al., 2007). The current study adds support to the effects of priming motivation (Levesque & Pelletier, 2003); and adds to the literature by highlighting that implicit measures of

motivation and priming of motivation are linked not just theoretically by methodologically – one sensitizes the other. These findings add to previous research that has augmented SDT with implicit measures of motivation (Keatley et al., 2012)

Conclusion

The research provides further support for the effects of motivation orientations from SDT at an implicit level on behavioural engagement. While there are several studies into the predictive validity of implicit measures of motivation, and the effects of priming of motivation (Keatley et al., 2012; Levesque & Pelletier, 2003), the present research is unique in bringing together these two paradigms to investigate their combined effects on behaviour. Attention should be given to the effect of completing implicit measures of motivational orientations from SDT on behaviour, above-and-beyond the outcomes of the IAT itself. Furthermore, attention should be given to the interaction between measuring implicit motivation, as proposed by SDT, and processes that could prime these motivational orientations, in future studies.

Chapter 7

General Discussion

Chapter 7 - General Discussion

The first aim of the current research was to investigate the role of impulsive motivational processes from self-determination theory affect behaviour. This was assessed in a number of studies by testing the predictive validity of implicit measures of motivation from self-determination theory across a range of behaviours (see Chapters 2 and 3). The second aim concerned the use of dual-systems models as a conceptual framework for understanding the unique and combined effects of implicit and explicit, or impulsive and reflective processes in motivation and behaviour, this was supported in all Chapters (except chapter 6, in which a dual-systems approach was not incorporated). The current thesis makes an important contribution to the literature by investigating and elucidating these aims and providing an important insight and foundation for future research in the area.

Integrating self-determination theory and implicit measures of motivation

The studies presented in the current thesis highlight the effect of implicitly measured motivation in individuals' behaviour. While research has traditionally viewed goal-directed behavioural engagement as being the result of planned, deliberative processes, the current thesis substantially adds to a growing trend in the literature supporting the role of implicit or impulsive processes in motivation and behaviour. The first studies provided limited support for the direct effect of implicit measures of motivation across health-related behaviours. However, this is not uncommon in the literature as a whole (Karpinski & Hilton, 2001), and most likely reflects the fact that different

behaviours may require different levels of planning or reflection before their initiation. For instance, brushing teeth is a regular behaviour for most people, and becomes routine. This habitual performance of the behaviour leads to less forethought or reflection being required in contrast to other behaviours like attending a gym class, which often requires packing a kit, time-planning etc. (Aarts & Dijksterhuis, 2000; Verplanken & Aarts, 1999). Therefore, the fact that relatively few of the health-related behaviours were predicted by the implicit measures of motivation does not diminish the role of implicit or impulsive processes in self-determination theory. The studies reported in this thesis provided an important contribution to understanding motivation from an SDT perspective by showing that the type of behaviour under observation is extremely important as to the relative contribution that implicit or explicit measures of motivation make in the prediction of variance in the behaviour.

Across the studies, implicitly measured motivation from SDT did significantly predict behaviour, an effect that was more pronounced when the type of behaviour was a) spontaneously provoked, and b) objectively measured. This is most clearly shown in the studies conducted in Chapter 4. SDT differentiates between motivation at a global level, and situation- or context-specific forms of motivation. For instance, a person may be generally autonomously motivated, but find certain situations or contexts controlling, thus thwarting their motivation orientation (Deci & Ryan, 1985). The fact that implicitly-measured motivation appears to have a more pronounced effect in certain circumstances (i.e., spontaneous behaviours) is therefore not out of keeping with the general SDT framework. This thesis therefore provides an

important contribution by outlining the differences in predictive validity or explicit and implicit measures of motivation for different types of behaviour, which has been highlighted as an important question when considering the factors that influence behaviour (Baumeister, 2007).

It remains unclear, however, whether implicit measures of motivation assess more long-term, trait-like motivation orientations or more situation-specific motivation. Given that individuals' general causality orientations provide a clear rationale for the results obtained via implicit measures of motivation, it seems to be likely that implicit measures provide an account of these more global, dispositional motivation orientations (Deci & Ryan, 1985). Furthermore, the study presented in Chapter 5 provides support for the long-term effect of implicitly measured motivation. Students' motivation, measured with the IAT, provided more consistent prediction of behaviour than explicit measures of motivation, including the GCOS. This seems to suggest that the IAT measures a more dispositional form of motivation that has an enduring effect over a long-term period.

A further issue relating to implicit measures of motivation was examined in the final study (Chapter 6). There is a growing amount of research showing that completion of an explicit measure of motivation or other psychological constructs affects subsequent behaviour – the mere measurement effect (Conner et al., 2011; Godin et al., 2010). The final study conducted here shows that this effect may also be present when individuals complete an

implicit measure of motivation. The results indicated that completion of the IAT lowered behavioural responses (attempts made at the task). Furthermore, there was a significant interaction between implicit measures of motivation and priming of autonomous motivation. This interaction indicates that the completion of the IAT for motivation may sensitise individuals to a more controlled motivation orientation. As the IAT is a relative measure of both autonomous and controlled motivation, it may be that this sensitising effect works by activating mental structures associated with controlled motivation, similar to a prime manipulation for controlled motivation. For this reason, full-counterbalancing should always be incorporated into research designs. Furthermore, as the implicit measure of motivation can provide significant prediction over an extended period (e.g., Chapter 5), it may be preferable to take measurement of individuals' motivation in one session and test behaviour in a later session. An alternative option would be to incorporate brief version of implicit measures, such as the brief-IAT (Sriram & Greenwald, 2009). This may reduce the effects on subsequent behaviour of completing an implicit measure of motivation

Therefore, there is now substantial support for implicit forms of motivation for a range of behaviours, which can be assessed through implicit measures, such as the IAT. Care should be taken when designing future studies in terms of the type of behaviour being researched, and the time of testing. Behaviours that entail some degree of planning or deliberation are less likely to be predicted by implicit measures of motivation. Furthermore, asking

individuals to complete an implicit measure of motivation can affect subsequent behaviour on a task.

The suitability of a dual-systems model

The second aim of the thesis was to investigate the suitability of a dual-systems model to provide a conceptual framework for the unique and combined effects of implicit and explicit motivation. There were several competing dual-process or dual-systems models at the start of the current thesis (Bargh & Chartrand, 1999; Fazio & Towles-Schwen, 1999; Strack & Deutsch, 2004; Wilson et al., 2000); however, Strack and Deutsch's (2004) RIM appeared to provide the most parsimonious account. Furthermore, the integration of motivation into the RIM, and the fact it had been supported across previous health-related behaviours (Hofmann, Friese, & Wiers, 2008, 2011) meant that it was deemed the most suitable for the current research. Based on the RIM, there are a series of possible patterns of interaction between the impulsive and reflective systems. Several of these patterns was tested throughout the current thesis, outlining the implications for self-determination theory and future research.

The first study posited that implicit measures of motivation would provide unique, independent prediction of behaviour, in addition to explicit measures (Perugini, 2005; Perugini et al., 2010). This additive pattern of predictive validity has been supported elsewhere in the literature (Asendorpf et al., 2002; Egloff & Schmukle, 2002). Given the issues relating to the

psychometric properties and use of implicit measures, support for the additive pattern highlights the incremental validity of implicit measures over explicit measures – an important finding for many practical purposes (Perugini & Banse, 2007). Although explicit measures are so much easier and practical to use, the finding that implicit measures can increase predictive validity was important for justifying its continued use in future research. The additional costs in time and resources that implicit measures incur, is offset by the increase in predictive validity.

The interactive, or mulitiplicative pattern of prediction was tested in the two studies presented in Chapter 4. The outcome variables in these studies were time spent completing novel, unexpected tasks. Therefore, the implicit measure of motivation was not impeded by issues of measurement-outcome correspondence. In both studies, the IAT showed incremental predictive validity above that of explicit measures of motivation. However, hypotheses relating to the interaction between implicit and explicit measures of motivation were not supported. A multiplicative pattern of prediction suggests that implicit and explicit measures of motivation interact synergistically to predict behaviour (Brunel, Tietje, & Greenwald, 2004). The lack of a significant interaction term, however, does not necessarily rule out the possibility of an interaction occurring. In both studies, participants with autonomous forms of implicit and explicit motivation spent significantly longer at the tasks. Several researchers have highlighted that the crucial point in whether a significant interaction is shown is whether the congruence between the implicit and explicit measures exert their influence contextually or chronically. In the latter

case, the congruence between the impulsive and reflective systems has already exerted its influence, resulting in increased main effects and an absence of significant interactions (Perugini et al., 2010). It remains unclear, therefore, whether the multiplicative pattern of prediction is supported in the current studies.

Looking across the studies in the current thesis, it is unclear which pattern of prediction provides a consistent representation of the effects of implicit and explicit motivation. There does appear to be a trend across the studies consistent with the theory that implicit measures of motivation predict spontaneous, unplanned behaviour better, while explicit measures of motivation are more effective in predicting deliberative behaviours. This finding is consistent with a other research in the literature that points towards this pattern (Moors & De Houwer, 2006). However, it should be noted that there is some support for an additive pattern across some the studies (e.g., Chapter 3). Essentially, because explicit and implicit measures predicted behaviours across most of the studies there does not appear to be a clear dissociation between measurement and behaviour types. Clearly, further research should be undertaken in which multiple different spontaneous or reflective behavioural outcomes are assessed. This may be done by either pre-warning participants of the task contrasted with spontaneously asking participants if they will complete a task (e.g., Perugini, Conner, & O'Gorman, 2011).

It is important to note for both of the studies focusing on implicit motivation and health-related behaviour, the reflective route in the RIM was also supported. In the reflective route, a series of deliberative, reasoned processes occur. The final stage of the reflective system involves these processes forming an intention to perform (or restrain) a behaviour. As the reflective system is independent from immediate perceptual input, it is within this system that future oriented plans can be created. Furthermore, strategies to achieve goals are also formulated in the reflective system. Therefore, intention is posited as the final mechanism of the reflective system. Intention has also been proposed as the most proximal determinant of behaviour in other models, such as the Theory of Planned Behaviour (TPB; Ajzen, 1991, 2002). The current research, therefore, adds support to TPB as well as the RIM.

Overall, it is unclear how well the current thesis supports the RIM. Though several of the studies appear to support particular patterns of prediction that can be derived from the RIM (e.g., additive, or double-dissociation), no single study within the current thesis provides support for all of the patterns of prediction. To fully support the RIM, it would be necessary to test more of these patterns and provide support for them. The double-dissociation should ideally be tested within one study, focusing on both spontaneous, automatic behaviours in contrast to planned, reflective behaviours. Therefore, the RIM appears to provide a fair conceptual framework for the role of reflective, explicit processes and impulsive, implicit processes; but, further research is required before it can be fully supported within the current motivation research. This further research should focus on two aspects, first, the strength of the RIM in motivation research, second,

which of the patterns of prediction the RIM best supports. Though several patterns have been discussed in the literature (see Perugini, 2005), it may be that a particular one of them (e.g., additive) may be the most reliable pattern that emerges from a dual-systems perspective, this therefore is less a limitation of the RIM and more a facet of dual-systems models in general

Limitations and future directions

An important issue is why the implicit measures of motivation from SDT did not provide significant predictions for more of the behaviours. An explanation for this, especially in the first studies involves the correspondence of measures. The first studies into health-related behaviours incorporated self-report follow-up measures. These self-report measures are more likely to assess reflective processes, which correspond more to explicit measures than implicit measures. Essentially, explicitly measured motivation and behaviour are likely to reflect deliberative processes, which implicit measures of motivation may not. The studies presented in Chapter 4 investigated whether implicit measures of motivation predicted more objective behavioural measures. Most important, these behaviours were also given to the participants without allowing for prior planning or deliberation and therefore reflect more spontaneous, unplanned behavioural engagement. The results from across these studies provide the most support and insight into the role of impulsive processes in self-determination theory.

One possibility to help overcome the issue of correspondence would be to develop implicit measures of motivation that focus on the context of the specific behaviour or content. This type of measure is typically used in implicit attitude studies (Greenwald & Nosek, 2001; Richetin et al., 2007). However, in terms of measuring implicit motivation, development of a context-specific measure presents challenges due to the need for three categories to be simultaneously measured (e.g., 'self', 'motivation', and 'behaviour'). This is most likely the reason why no such measure currently exists. One option would be to present pictures in the background of the implicit measure; or specifically target individuals' awareness toward a particular behaviour. The development of such a measure was beyond the scope of the current research. Future research could attempt to develop such a measure; however, the standard two-category IAT used in the current studies measures more global motivational orientations and shows predictive validity for a number of behaviours.

The implicit association test was used for the all but the first of the studies presented in the current thesis. As outlined, the IAT provides a relative measure of individuals' autonomous and controlled motivation orientation. Though it may be scored such that higher scores are indicative of a more autonomous orientation, this is not the same as separately measuring each motivation orientation. It remains unclear, which implicit measurement technique is most suitable for measuring motivation from self-determination theory. The issue of whether a relative measure or separate indices is preferable is reflected in explicit measures of motivation from self-

determination theory. For instance, scoring the relative autonomy index (RAI), which was used in several studies here, weights motivation subtypes so that higher overall scores are indicative of an autonomous motivation orientation, similar to IAT scoring. For instance, external regulation is weighted with a factor of -2, introjected motivation with a factor of -1, identified regulation with a factor of +1 and intrinsic regulation with a factor of +2. In contrast, scales such as the intrinsic motivation inventory (IMI) and perceived locus of causality (PLOC) scales provide separate measurement of each of the motivation subtypes from SDT.

Future research should seek to test which form of implicit measurement is preferable. It may be the case that certain research paradigms are more amenable to being tested with a relative implicit measure, while others would be better assessed with separate scales. For example, is the implicit measure is being used as a generalised gauge of individuals' motivation orientation; then, a relative measure may provide an adequate account. In contrast, if it is important to understand possible conflicts in motivation toward a particular activity or behaviour, separate measures of implicit autonomous and controlled motivation may be better than a relative measure.

In addition to the issue of whether motivation from self-determination theory should be measured with a relative measure or single-category measures, is which of these measures provides consistently valid predictions. At present, the IAT is the most widely used and supported implicit measure in

the literature; however, this is not to say that is without limitations. Several competing implicit measures have therefore been proposed; for example, the single-category implicit association test (SC-IAT; Karpinski & Steinman, 2006). To date, there are very few studies that have set out to directly contrast the predictive validity of these implicit measures in a single study. This is needed within the literature, in order to understand which measures provide consistently better predictions for behaviours. While this is a methodological problem, it should remain of central important to future research. Scale development and psychometric testing using explicit measures is a lengthy process involving a number of important stages. A similar set of stringent tests should be conducted with implicit measures.

A further area for future research, based on the current series of studies, would be to investigate the interaction between implicit measures of motivation and the context individuals are in. There is a large amount of research consistently showing how the context a person is may affect their motivation (Deci & Ryan, 1985; Ryan & Connell, 1989; Ryan & Deci, 2000a, 2000b). For instance, controlling environments entailing rewards and/or punishment have the potential to undermine individuals' more autonomous forms of motivation. Measuring the effects of different contexts on implicitly measured motivation would show whether changes in context affect implicit motivation. This research would help to elucidate whether implicit measures provide a more generalised, trait-like measurement of individuals' motivation orientation, or whether implicit measures reflect ephemeral motivation. Furthermore, it would be important to see how separate measures of implicit

autonomous and controlled motivation are affected by different motivational contexts. For example, future research could investigate whether a controlling context decreases implicit autonomous motivation or increases implicit controlled motivation, or a combination of both.

Finally, a further area for future research would be to investigate the possibility of implicit motivation providing a 'protective' effect for individuals in different motivational contexts. Individuals with an autonomous motivation orientation are likely to interpret novel situations in a manner that is conducive to maintaining their autonomous motivation. This may lead to amelioration of the generally undermining effect of controlling contexts. However, it is unclear whether an implicit autonomous motivation orientation leads to a similar reinterpretation of the context, therefore protecting the individual from the undermining effect of their current context. Given the growing support for a double-dissociation pattern between implicit and explicit measures, it may be that implicit autonomous motivation only shows this protective effect in situations that are unexpectedly or suddenly controlling. Given the prior awareness, individuals have the opportunity to reflect on the forthcoming context and therefore their reflective motivation orientation assumes the dominant role. However, if an individual is suddenly placed in a controlling situation that they did not expect or have a chance to prepare for, their impulsive system may provide the initial response.

Conclusion

Overall, the current thesis provides support for the use of implicit measures of motivation from SDT. While the literature is replete with studies that focus on the effects of explicitly measured motivation, this thesis offers repeated support for the role of implicit motivation in a variety of goal-directed behaviours. Furthermore, the adoption of a dual-systems model (RIM) as a conceptual framework for understanding the effects of implicitly and explicitly measured motivation is also supported. The results from across the studies indicate that certain behaviours may be better predicted by implicit measures of motivation. Generally, explicit measures of motivation account for more variance in planned behaviours or when behaviours are measured explicitly, as in the studies reported in Chapters 2 and 3. Behaviours that require less planning or are more spontaneous in their initiation are likely to be better predicted by implicit motivation. The thesis also shows that the mere measurement effect may also occur at the implicit level – a finding only shown previously for explicitly measured constructs.

Studies investigating the motivational antecedents from SDT on goal-directed behaviour should seek to incorporate both implicit and explicit measures of motivation in order to assess the full gamete of motivational influences. Several key areas remain in need of further investigation, such as: developing more reliable, valid separate measures of autonomous and controlled motivation, and the interaction between measurement and manipulation of the impulsive system.

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Appendices

Appendix 1 – Example questionnaire (Chapters 2 and 3)

YOUR OPINIONS ABOUT YOUR EVERYDAY PASS TIMES AND BEHAVIOURS

Thank you for agreeing to participate in our survey which asks your *opinions* about your participation in *everyday past-times* and *behaviours*. Everyone feels differently about this so there are no right or wrong answers, we are interested in your *opinions*. Do not spend too long on any one statement and give the response that best describes your feelings. All responses are strictly *confidential*, and please answer *all the questions*. For each pass time/ behaviour please read all of the statements and CIRCLE A NUMBER **for each.**

Control calorie intake to control weight

*(Remember to circle a number for **every** reason)*

1. **I control calorie intake to control weight because...**	**Not true at all**			**Very true**
...I enjoy controlling calorie intake to control weight	**1**	**2**	**3**	**4**
...I value the benefits of controlling calorie intake to control weight	**1**	**2**	**3**	**4**
...I will feel guilty if I do not control calorie intake to control weight	**1**	**2**	**3**	**4**
...people I know well (e.g., friend, parents etc.) say I should control calorie intake to control weight	**1**	**2**	**3**	**4**
...it is fun to control calorie intake to control weight	**1**	**2**	**3**	**4**
....I think it is important to make the effort to control calorie intake to control weight	**1**	**2**	**3**	**4**
...I will feel ashamed if I do not control calorie intake to control weight	**1**	**2**	**3**	**4**
...I feel under pressure to control calorie intake to control weight from people I know well (e.g., friends, parents etc.)	**1**	**2**	**3**	**4**

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to control calorie intake to control weight during my spare time in the next 2 weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I plan to control calorie intake to control weight during my spare time in the next 2 weeks.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Eat low-fat foods

1. I Eat low-fat foods because...	**Not true at all**			**Very true**
...I enjoy eating low-fat foods	**1**	**2**	**3**	**4**
...I value the benefits of eating low-fat foods	**1**	**2**	**3**	**4**
...I will feel guilty if I do not eat low-fat foods	**1**	**2**	**3**	**4**
...people I know well (e.g., friend, parents etc.) say I should eat low-fat foods	**1**	**2**	**3**	**4**
...it is fun to eat low-fat foods	**1**	**2**	**3**	**4**
....I think it is important to make the effort to eat low-fat foods	**1**	**2**	**3**	**4**
...I will feel ashamed if I do not eat low-fat foods	**1**	**2**	**3**	**4**

...I feel under pressure to eat low-fat foods from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to eat low-fat foods during my spare time in the next 2 weeks	1	2	3	4	5	6	7
I plan to go eat low-fat foods during my spare time in the next 2 weeks	1	2	3	4	5	6	7

Wear a seat belt when in cars/taxis

1. I wear a seat belt when in cars/taxis because...	**Not true at all**		
...I enjoy wearing a seat belt when in cars/taxis	1	2	3
...I value the benefits of wearing a seat belt when in cars/taxis	1	2	3
...I will feel guilty if I do not wear a seat belt when in cars/taxis	1	2	3
...people I know well (e.g., friend, parents etc.) say I should wear a seat belt when in cars/taxis	1	2	3
...it is fun to wear a seat belt when in cars/taxis	1	2	3
....I think it is important to make the effort to wear a seat belt when in cars/taxis regularly	1	2	3

	Not true at all			Very true
...I will feel ashamed if I do not wear a seat belt when in cars/taxis	1	2	3	4
...I feel under pressure to wear a seat belt when in cars/taxis from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to wear a seat belt when in cars/taxis during my spare time in the next 2 weeks	1	2	3	4	5	6	7
I plan to wear a seat belt when in cars/taxis during my spare time in the next 2 weeks	1	2	3	4	5	6	7

Get a good night's sleep

1. I get a good night's sleep because...	**Not true at all**			**Very true**
...I enjoy it when I manage to get a good night's sleep	1	2	3	4
...I value the benefits of getting a good night's sleep	1	2	3	4
...I will feel guilty if I do not get a good night's sleep	1	2	3	4

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...people I know well (e.g., friend, parents etc.) say I should get a good night's sleep	1	2	3	4
...it is fun to get a good night's sleep	1	2	3	4
....I think it is important to make the effort to get a good night's sleep	1	2	3	4
...I will feel ashamed if I do not get a good night's sleep	1	2	3	4
...I feel under pressure to get a good night's sleep from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to get a good night's sleep in the next 2 weeks	1	2	3	4	5	6	7
I plan to get a good night's sleep in the next 2 weeks	1	2	3	4	5	6	7

Drinking alcohol

I drink within the recommended number of units of alcohol per week (14 for women, 21 for men) because...	**Not true at all**			**Very true**
...I enjoy drinking within the recommended number of units of alcohol per week	**1**	**2**	**3**	**4**
...I value the benefits of drinking within the recommended number of units of alcohol per week	**1**	**2**	**3**	**4**
...I will feel guilty if I do not drink within the recommended number of units of alcohol per week	**1**	**2**	**3**	**4**
...people I know well (e.g., friend, parents etc.) say I should drink within the recommended number of units of alcohol per week	**1**	**2**	**3**	**4**
...it is fun to drink within the recommended number of units of alcohol per week	**1**	**2**	**3**	**4**
....I think it is important to make the effort to drink within the recommended number of units of alcohol per week regularly	**1**	**2**	**3**	**4**
...I will feel ashamed if I do not drink within the recommended number of units of alcohol per week	**1**	**2**	**3**	**4**
...I feel under pressure to drink within the recommended number of units of alcohol per week from people I know well (e.g., friends, parents etc.)	**1**	**2**	**3**	**4**

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to drink within the recommended number of units of alcohol per week (14 for women, 21 for men) in the next 2 weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**

I plan to drink within the recommended number of units of alcohol per week (14 for women, 21 for men) in the next 2 weeks	1	2	3	4	5	6	7

Using condoms

I use condoms when having sex because...	Not true at all			Very true
...I enjoy using condoms when having sex	1	2	3	4
...I value the benefits of using condoms	1	2	3	4
...I will feel guilty if I do not use condoms	1	2	3	4
...people I know well (e.g., friend, parents etc.) say I should use condoms	1	2	3	4
...it is fun to use condoms	1	2	3	4
....I think it is important to make the effort to use condoms regularly	1	2	3	4
...I will feel ashamed if I do not use condoms	1	2	3	4
...I feel under pressure to use condoms from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to use condoms when having sex in the next 2 weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I plan to use condoms when having sex in the next 2 weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Wash my hands before preparing and handling food

I wash my hands before preparing and handling food because...	**Not true at all**			**Very true**
...I enjoy washing my hands before preparing and handling food	**1**	**2**	**3**	**4**
...I value the benefits of washing my hands before preparing and handling food	**1**	**2**	**3**	**4**
...I will feel guilty if I do not wash my hands before preparing and handling food	**1**	**2**	**3**	**4**
...people I know well (e.g., friend, parents etc.) say I should wash my hands before preparing and handling food	**1**	**2**	**3**	**4**
...it is fun to wash my hands before preparing and handling food	**1**	**2**	**3**	**4**
....I think it is important to make the effort to wash my hands before preparing and handling food	**1**	**2**	**3**	**4**

...I will feel ashamed if I do not wash my hands before preparing and handling food	1	2	3	4
...I feel under pressure to wash my hands before preparing and handling food from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to wash my hands before preparing and handling food during my spare time in the next 2 weeks	1	2	3	4	5	6	7
I plan to wash my hands before preparing and handling food during my spare time in the next 2 weeks	1	2	3	4	5	6	7

Take walks or time-out to relax and wind down

I take walks or time-out to relax and wind down because...	**Not true at all**			**Very true**
...I enjoy taking walks or time-out to relax and wind down	1	2	3	4
...I value the benefits of taking walks or time-out to relax and wind down	1	2	3	4
...I will feel guilty if I do not take walks or time-out to relax and wind down	1	2	3	4

...people I know well (e.g., friend, parents etc.) say I should take walks or time-out to relax and wind down	1	2	3	4
...it is fun to take walks or time-out to relax and wind down	1	2	3	4
....I think it is important to make the effort to take walks or time-out to relax and wind down	1	2	3	4
...I will feel ashamed if I do not take walks or time-out to relax and wind down	1	2	3	4
...I feel under pressure to take walks or time-out to relax and wind down from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to take walks or time-out to relax and wind down in the next 2 weeks	1	2	3	4	5	6	7
I plan to take walks or time-out to relax and wind down in the next 2 weeks	1	2	3	4	5	6	7

Brushing your teeth

I brush my teeth every day because...	**Not true at all**			**Very true**
...I enjoy brushing my teeth every day	1	2	3	4

...I value the benefits of brushing my teeth every day	1	2	3	4
...I will feel guilty if I do not brush my teeth every day	1	2	3	4
...people I know well (e.g., friend, parents etc.) say I should brush my teeth every day	1	2	3	4
...it is fun to brush my teeth every day	1	2	3	4
....I think it is important to make the effort to brush my teeth every day	1	2	3	4
...I will feel ashamed if I do not brush my teeth every day	1	2	3	4
...I feel under pressure to brush my teeth every day from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to brush my teeth every day in the next 2 weeks	1	2	3	4	5	6	7
I plan to brush my teeth every day in the next 2 weeks	1	2	3	4	5	6	7

Avoid eating junk food

I avoid eating junk food because...	**Not true at all**			**Very true**
...I enjoy avoiding eating junk food	1	2	3	4

...I value the benefits avoiding eating junk food	1	2	3	4
...I will feel guilty if I eat junk food	1	2	3	4
...people I know well (e.g., friend, parents etc.) say I should avoid eating junk food	1	2	3	4
...it is fun to avoid eating junk food	1	2	3	4
....I think it is important to make the effort to avoid eating junk food regularly	1	2	3	4
I avoid eating junk food because...	**Not true at all**			**Very true**
...I will feel ashamed if I eat junk food	1	2	3	4
...I feel under pressure to avoid eating junk food from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to avoid eating junk food in the next 2 weeks	1	2	3	4	5	6	7
I plan to avoid eating junk food in the next 2 weeks	1	2	3	4	5	6	7

Reducing caffeine and stimulants

I reduce consuming caffeine and other legal stimulants because...	Not true at all			Very true
...I enjoy reducing consuming caffeine and other legal stimulants	1	2	3	4
...I value the benefits of reducing consuming caffeine and other legal stimulants	1	2	3	4
...I will feel guilty if I consume caffeine and other legal stimulants	1	2	3	4
...people I know well (e.g., friend, parents etc.) say I should reduce consuming caffeine and other legal stimulants	1	2	3	4
...it is fun to reduce consuming caffeine and other legal stimulants	1	2	3	4
....I think it is important to reduce consuming caffeine and other legal stimulants regularly	1	2	3	4
...I will feel ashamed if I consume caffeine and other legal stimulants	1	2	3	4
...I feel under pressure to reduce consuming caffeine and other legal stimulants from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to reduce consuming caffeine and other legal stimulants in the next 2 weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I plan to reduce consuming caffeine and other legal stimulants in the next 2 weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Use stairs instead of a lift or escalator

I use stairs instead of a lift or escalator because...	**Not true at all**			**Very true**
...I enjoy using stairs instead of a lift or escalator	**1**	**2**	**3**	**4**
...I value the benefits of using stairs instead of a lift or escalator	**1**	**2**	**3**	**4**
...I will feel guilty if I do not using stairs instead of a lift or escalator	**1**	**2**	**3**	**4**
...people I know well (e.g., friend, parents etc.) say I should use stairs instead of a lift or escalator	**1**	**2**	**3**	**4**
...it is fun to go use stairs instead of a lift or escalator	**1**	**2**	**3**	**4**
....I think it is important to make the effort to use stairs instead of a lift or escalator regularly	**1**	**2**	**3**	**4**
...I will feel ashamed if I do not use stairs instead of a lift or escalator	**1**	**2**	**3**	**4**
...I feel under pressure to use stairs instead of a lift or escalator from people I know well (e.g., friends, parents etc.)	**1**	**2**	**3**	**4**

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to use stairs instead of a lift or escalator in the next 2 weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I plan to use stairs instead of a lift or escalator in the next 2 weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Wash my hands after going to the toilet

I wash my hands after going to the toilet because...	**Not true at all**			**Very true**
...I enjoy washing my hands after going to the toilet	**1**	**2**	**3**	**4**
...I value the benefits of washing my hands after going to the toilet	**1**	**2**	**3**	**4**
...I will feel guilty if I do not wash my hands after going to the toilet	**1**	**2**	**3**	**4**
...people I know well (e.g., friend, parents etc.) say I should wash my hands after going to the toilet	**1**	**2**	**3**	**4**
...it is fun to wash my hands after going to the toilet	**1**	**2**	**3**	**4**
....I think it is important to make the effort to wash my hands after going to the toilet	**1**	**2**	**3**	**4**
...I will feel ashamed if I do not wash my hands after going to the toilet	**1**	**2**	**3**	**4**

...I feel under pressure to wash my hands after going to the toilet from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to wash my hands after going to the toilet in the next 2 weeks	1	2	3	4	5	6	7
I plan to wash my hands after going to the toilet in the next 2 weeks	1	2	3	4	5	6	7

Take extra supplements to maintain a healthy diet (e.g., vitamin tablets, protein drinks, creatine etc)

Take extra supplements to maintain a healthy diet because...	**Not true at all**			**Very true**
...I enjoy taking extra supplements to maintain a healthy diet	1	2	3	4
...I value the benefits of taking extra supplements to maintain a healthy diet	1	2	3	4
...I will feel guilty if I do not take extra supplements to maintain a healthy diet	1	2	3	4
...people I know well (e.g., friend, parents etc.) say I should take extra supplements to maintain	1	2	3	4

a healthy diet				
...it is fun to take extra supplements to maintain a healthy diet	1	2	3	4
....I think it is important to make the effort to take extra supplements to maintain a healthy diet	1	2	3	4
...I will feel ashamed if I do not take extra supplements to maintain a healthy diet	1	2	3	4
...I feel under pressure to take extra supplements to maintain a healthy diet from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to take extra supplements to maintain a healthy diet during my spare time in the next 2 weeks	1	2	3	4	5	6	7
I plan to take extra supplements to maintain a healthy diet during my spare time in the next 2 weeks	1	2	3	4	5	6	7

Exercise regularly (3-4 times per week)

I exercise regularly (3-4 times per week) because...	**Not true at all**			**Very true**
...I enjoy exercising regularly	1	2	3	4
...I value the benefits of exercising regularly	1	2	3	4

...I will feel guilty if I do not exercise regularly	1	2	3	4
...people I know well (e.g., friend, parents etc.) say I should exercise regularly	1	2	3	4
...it is fun to exercise regularly	1	2	3	4
....I think it is important to make the effort to exercise regularly	1	2	3	4
...I will feel ashamed if I do not exercise regularly	1	2	3	4
...I feel under pressure to exercise regularly from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to exercise regularly during my spare time in the next 2 weeks	1	2	3	4	5	6	7
I plan to exercise regularly during my spare time in the next 2 weeks	1	2	3	4	5	6	7

Plan work in advance to reduce stress

I plan work in advance to reduce stress because...	**Not true at all**			**Very true**
...I enjoy planning work in advance to reduce stress	1	2	3	4
...I value the benefits of planning work in	1	2	3	4

advance to reduce stress				
...I will feel guilty if I do not plan work in advance to reduce stress	1	2	3	4
...people I know well (e.g., friend, parents etc.) say I should plan work in advance to reduce stress	1	2	3	4
...it is fun to plan work in advance to reduce stress	1	2	3	4
....I think it is important to make the effort to plan work in advance to reduce stress	1	2	3	4
...I will feel ashamed if I do not plan work in advance to reduce stress	1	2	3	4
...I feel under pressure to plan work in advance to reduce stress from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to plan work in advance to reduce stress during my spare time in the next 2 weeks	1	2	3	4	5	6	7
I plan to plan work in advance to reduce stress during my spare time in the next 2 weeks	1	2	3	4	5	6	7

Sitting with correct posture

I sit with correct posture to avoid back pain because...	**Not true at all**			**Very true**
...I enjoy sitting with correct posture to avoid back pain	1	2	3	4

...I value the benefits of sitting with correct posture to avoid back pain	1	2	3	4
...I will feel guilty if I do not sit with correct posture to avoid back pain	1	2	3	4
...people I know well (e.g., friend, parents etc.) say I should sit with correct posture to avoid back pain	1	2	3	4
...it is fun to sit with correct posture to avoid back pain	1	2	3	4
....I think it is important to make the effort to sit with correct posture to avoid back pain regularly	1	2	3	4
...I will feel ashamed if I do not sit with correct posture to avoid back pain	1	2	3	4
...I feel under pressure to sit with correct posture to avoid back pain from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to sit with correct posture to avoid back pain in the next 2 weeks	1	2	3	4	5	6	7
I plan to sit with correct posture to avoid back pain in the next 2 weeks	1	2	3	4	5	6	7

<u>Avoiding foods high in sodium/salt (e.g., salted, pickled or smoked products)</u>

I avoid foods high in sodium/salt (e.g., salted, pickled or smoked products) because...	**Not true at all**			**Very true**
	1	2	3	4
...I enjoy avoiding foods high in sodium/salt				

...I value the benefits avoiding foods high in sodium/salt	1	2	3	4
...I will feel guilty if I do not avoid foods high in sodium/salt	1	2	3	4
...people I know well (e.g., friend, parents etc.) say I should avoid foods high in sodium/salt	1	2	3	4
...it is fun to avoid foods high in sodium/salt	1	2	3	4
....I think it is important to make the effort to avoid foods high in sodium/salt	1	2	3	4
...I will feel ashamed if I do not avoid foods high in sodium/salt	1	2	3	4
...I feel under pressure to avoid foods high in sodium/salt from people I know well (e.g., friends, parents etc.)	1	2	3	4

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to avoid foods high in sodium/salt during my spare time in the next 2 weeks	1	2	3	4	5	6	7
I plan to avoid foods high in sodium/salt during my spare time in the next 2 weeks	1	2	3	4	5	6	7

Eating sufficient foods with dietary fibre (roughage) (e.g., wholegrain cereals and bread, fruit and vegetables)

I eat sufficient foods with dietary fibre (roughage) (e.g., wholegrain cereals and bread, fruit and vegetables) because...	**Not true at all**			**Very true**
...I enjoy eating sufficient foods with dietary fibre	**1**	**2**	**3**	**4**
...I value the benefits of eating sufficient foods with dietary fibre	**1**	**2**	**3**	**4**
...I will feel guilty if I do not eat sufficient foods with dietary fibre	**1**	**2**	**3**	**4**
...people I know well (e.g., friend, parents etc.) say I should eat sufficient foods with dietary fibre	**1**	**2**	**3**	**4**
...it is fun to eat sufficient foods with dietary fibre	**1**	**2**	**3**	**4**
....I think it is important to make the effort to eat sufficient foods with dietary fibre	**1**	**2**	**3**	**4**
...I will feel ashamed if I do not eat sufficient foods with dietary fibre	**1**	**2**	**3**	**4**
...I feel under pressure to eat sufficient foods with dietary fibre from people I know well (e.g., friends, parents)	**1**	**2**	**3**	**4**

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to eat sufficient foods with dietary fibre	**1**	**2**	**3**	**4**	**5**	**6**	**7**

during my spare time in the next 2 weeks							
I plan to eat sufficient foods with dietary fibre during my spare time in the next 2 weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Eating fruit/vegetables

I eat 5 portions of fruit and vegetables a day because...	**Not true at all**			**Very true**
...I enjoy eating 5 portions of fruit and vegetables a day	**1**	**2**	**3**	**4**
...I value the benefits of eating 5 portions of fruit and vegetables a day	**1**	**2**	**3**	**4**
...I will feel guilty if I do not eat 5 portions of fruit and vegetables a day	**1**	**2**	**3**	**4**
...people I know well (e.g., friend, parents etc.) say I should eat 5 portions of fruit and vegetables a day	**1**	**2**	**3**	**4**
...it is fun to eat 5 portions of fruit and vegetables a day	**1**	**2**	**3**	**4**
....I think it is important to make the effort to eat 5 portions of fruit and vegetables regularly	**1**	**2**	**3**	**4**
...I will feel ashamed if I do not eat 5 portions of fruit and vegetables a day	**1**	**2**	**3**	**4**
...I feel under pressure to eat 5 portions of fruit and vegetables a day from people I know well	**1**	**2**	**3**	**4**

(e.g., friends, parents etc.)

Read the statements below and circle the number on the right that best describes your answer	**Strongly Disagree**						**Strongly agree**
I intend to eat 5 portions of fruit and vegetables a day in the next 2 weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I plan to eat 5 portions of fruit and vegetables a day in the next 2 weeks	**1**	**2**	**3**	**4**	**5**	**6**	**7**

WHAT I AM LIKE

In this section, please read the pairs of statements, one pair at a time, and think about which statement within the pair seems more true for you. Indicate the degree to which statement A feels true, relative to the degree that Statement B feels true, on the 5-point scale shown after each pair of statements. If statement A feels completely true and statement B feels completely untrue, the appropriate response would be 1. If the two statements are equally true, the appropriate response would be a 3. If only statement B feels true, the appropriate response would be a 5; and so on.

1. A. I always feel like I choose the things I do.
   B. I sometimes feel that it's not really me choosing the things I do.

   Only A feels true 1 2 3 4 5 **Only B feels true**

2. A. My emotions sometimes seem alien to me.
   B. My emotions always seem to belong to me.

   Only A feels true 1 2 3 4 5 **Only B feels true**

3. A. I choose to do what I have to do.
   B. I do what I have to, but I don't feel like it is really my choice.

   Only A feels true 1 2 3 4 5 **Only B feels true**

4. A. I feel that I am rarely myself.
   B. I feel like I am always completely myself.

   Only A feels true 1 2 3 4 5 **Only B feels true**

5. A. I do what I do because it interests me.
   B. I do what I do because I have to.

Only A feels true	1	2	3	4	5	**Only B feels true**

6. A. When I accomplish something, I often feel it wasn't really me who did it.
   B. When I accomplish something, I always feel it's me who did it.

Only A feels true	1	2	3	4	5	**Only B feels true**

7. A. I am free to do whatever I decide to do.
   B. What I do is often not what I'd choose to do.

Only A feels true	1	2	3	4	5	**Only B feels true**

8. A. My body sometimes feels like a stranger to me.
   B. My body always feels like me.

Only A feels true	1	2	3	4	5	**Only B feels true**

9. A. I feel pretty free to do whatever I choose to.
   B. I often do things that I don't choose to do.

Only A feels true	1	2	3	4	5	**Only B feels true**

10. A. Sometimes I look into the mirror and see a stranger.
    B. When I look into the mirror I see myself.

Only A feels true	1	2	3	4	5	**Only B feels true**

PART 3

These items pertain to a series of hypothetical sketches. Each sketch describes an incident and lists three ways of responding to it. Please read each sketch, imagine yourself in that situation, and then consider each of the possible responses. Think of each response option in terms of how likely it is that you would respond that way. (We all respond in a variety of ways to situations, and probably most or all responses are at least slightly likely for you.) If it is very unlikely that you would respond the way described in a given response, you should circle answer 1 or 2. If it is moderately likely, you would select a number in the mid range, and if it is very likely that you would respond as described, you would circle answer 6 or 7.

1. You have been offered a new position in a company where you have worked for some time. The first question that is likely to come to mind is:

a) What if I can't live up to the new responsibility?

1 2 3 4 5 6 7

very unlikely very likely

b) Will I make more at this position?

1 2 3 4 5 6 7

very unlikely very likely

c) I wonder if the new work will be interesting.

1 2 3 4 5 6 7

very unlikely very likely

2. **You have a school-age daughter. On parents' night the teacher tells you that your daughter is doing poorly and doesn't seem involved in the work. You are likely to:**

a) Talk it over with your daughter to understand further what the problem is.

1 2 3 4 5 6 7

very unlikely very likely

b) Scold her and hope she does better.

1 2 3 4 5 6 7

very unlikely very likely

c) Make sure she does the assignments, because she should be working harder.

1 2 3 4 5 6 7

very unlikely very likely

3. **You had a job interview several weeks ago. In the mail you received a form letter which states that the position has been filled. It is likely that you might think:**

a) It's not what you know, but who you know.

1 2 3 4 5 6 7

very unlikely very likely

b) I'm probably not good enough for the job.

1 2 3 4 5 6 7

very unlikely very likely

c) Somehow they didn't see my qualifications as matching their needs.

1 2 3 4 5 6 7

very unlikely very likely

4. **You are a plant supervisor and have been charged with the task of allotting coffee breaks to three workers who cannot all break at once. You would likely handle this by:**

a) Telling the three workers the situation and having them work with you on the schedule.

1 2 3 4 5 6 7

very unlikely very likely

b) Simply assigning times that each can break to avoid any problems.

1 2 3 4 5 6 7

very unlikely very likely

c) Find out from someone in authority what to do or do what was done in the past.

1 2 3 4 5 6 7

very unlikely very likely

5. A close (same-sex) friend of yours has been moody lately, and a couple of times has become very angry with you over "nothing." You might:

a) Share your observations with him/her and try to find out what is going on for him/her.

1 2 3 4 5 6 7

very unlikely very likely

b) Ignore it because there's not much you can do about it anyway.

1 2 3 4 5 6 7

very unlikely very likely

c) Tell him/her that you're willing to spend time together if and only if he/she makes more effort to control him/herself.

1 2 3 4 5 6 7

very unlikely very likely

6. You have just received the results of a test you took, and you discovered that you did very poorly. Your initial reaction is likely to be:

a) "I can't do anything right," and feel sad.

1 2 3 4 5 6 7

very unlikely very likely

b) "I wonder how it is I did so poorly," and feel disappointed.

1 2 3 4 5 6 7

very unlikely very likely

c) "That stupid test doesn't show anything," and feel angry.

1 2 3 4 5 6 7

very unlikely very likely

7. **You have been invited to a large party where you know very few people. As you look forward to the evening, you would likely expect that:**

a) You'll try to fit in with whatever is happening in order to have a good time and not look bad.

1 2 3 4 5 6 7

very unlikely very likely

b) You'll find some people with whom you can relate.

1 2 3 4 5 6 7

very unlikely very likely

c) You'll probably feel somewhat isolated and unnoticed.

1 2 3 4 5 6 7

very unlikely very likely

8. You are asked to plan a picnic for yourself and your fellow employees. Your style for approaching this project could most likely be characterized as:

a) Take charge: that is, you would make most of the major decisions yourself.

1 2 3 4 5 6 7

very unlikely very likely

b) Follow precedent: you're not really up to the task so you'd do it the way it's been done before.

1 2 3 4 5 6 7

very unlikely very likely

c) Seek participation: get inputs from others who want to make them before you make the final plans.

1 2 3 4 5 6 7

very unlikely very likely

9. Recently a position opened up at your place of work that could have meant a promotion for you. However, a person you work with was offered the job rather than you. In evaluating the situation, you're likely to think:

a) You didn't really expect the job; you frequently get passed over.

1 2 3 4 5 6 7

very unlikely very likely

b) The other person probably "did the right things" politically to get the job.

1 2 3 4 5 6 7

very unlikely very likely

c) You would probably take a look at factors in your own performance that led you to be passed over.

1 2 3 4 5 6 7

very unlikely very likely

10.You are embarking on a new career. The most important consideration is likely to be:

a) Whether you can do the work without getting in over your head.

1 2 3 4 5 6 7

very unlikely very likely

b) How interested you are in that kind of work.

1 2 3 4 5 6 7

very unlikely very likely

c) Whether there are good possibilities for advancement.

1 2 3 4 5 6 7

very unlikely very likely

11. A woman who works for you has generally done an adequate job. However, for the past two weeks her work has not been up to par and she appears to be less actively interested in her work. Your reaction is likely to be:

a) Tell her that her work is below what is expected and that she should start working harder.

1 2 3 4 5 6 7

very unlikely very likely

b) Ask her about the problem and let her know you are available to help work it out.

1 2 3 4 5 6 7

very unlikely very likely

c) It's hard to know what to do to get her straightened out.

1 2 3 4 5 6 7

very unlikely very likely

12. Your company has promoted you to a position in a city far from your present location. As you think about the move you would probably:

a) Feel interested in the new challenge and a little nervous at the same time.

1 2 3 4 5 6 7

very unlikely very likely

b) Feel excited about the higher status and salary that is involved.

1 2 3 4 5 6 7

very unlikely very likely

c) Feel stressed and anxious about the upcoming changes.

1 2 3 4 5 6 7

very unlikely very likely

YOUR OPINIONS ABOUT YOUR EVERYDAY PASS TIMES AND BEHAVIOURS

Thank you for agreeing to participate in the second part of our survey which asks your ***opinions*** about your participation in *everyday pass times* and *behaviours* in the ***past four weeks***. Everyone does things differently so there are no right or wrong answers, we are interested what you ***actually do***. Do not spend too long on any one statement and give the response that best describes your actions. All responses are strictly ***confidential***, and please answer ***all the questions***.

In the course of the past 4 weeks, how often have you controlled your calorie intake to control weight *(Please tick one box)*

Never	Hardly ever	Very occasionally	Occasionally	A few times	Often	Very often

In the course of the past 4 weeks, how often have you eaten low-fat foods? *(Please tick one box)*

Never	Once or twice	A few times	A few times, but less than half the days	On about half the days	Most days	Almost everyday

In the course of the past 4 weeks, how often have you worn a seatbelt when using a car or taxi? *(Please tick one box)*

Never	Hardly ever	Very occasionally	Occasionally	A few times	Often	Every time

In the course of the past 4 weeks, how many times have you had a good night's sleep?
(Please tick one box)

Never	Once or twice	A few times	A few times, but less than half the days	On about half the days	Most days	Almost everyday

In the course of the past 4 weeks, how often have you consumed alcohol within (i.e. equal to or less than) the recommended number or units of alcohol (2 units/day for women, 3 units/day for men)? *(Please tick one box)*

Never	Hardly ever	Very occasionally	Occasionally	A few times	Often	Very often

In the course of the past 4 weeks, how often have you used condoms when having sex (tick not applicable only if you have not been sexually active)? *(Please tick one box)*

Not applicable	Never	Hardly ever	Very occasionally	Occasionally	A few times	Often	Every tim

In the course of the past 4 weeks, how many times have you washed your hands before preparing or handling food? *(Please tick one box)*

Never	Hardly ever	Very occasionally	Occasionally	A few times	Often	Every time

In the course of the past 4 weeks, how often have you taken walks or time-out to relax and unwind? *(Please tick one box)*

Never	Hardly ever	Very occasionally	Occasionally	A few times	Often	Very often

In the course of the past 4 weeks, how often have you brushed your teeth? *(Please tick one box)*

Never	Once or twice	A few times	A few times, but less than half the days	On about half the days	Most days	Almost everyday

In the course of the past 4 weeks, how often have you avoided eating junk food? *(Please tick one box)*

Never	Once or twice	A few times	A few times, but less than half the days	On about half the days	Most days	Almost everyday

In the course of the past 4 weeks, how much have you reduced your consumption of caffeine or other legal stimulants? *(Please tick one box)*

Not had any	Had once or twice	Had a few times	Had a few times, but less than half the days	Had on about half the days	Had most days	Had lots

In the course of the past 4 weeks, how often have you attended used stairs instead of a lift or escalator? *(Please tick one box)*

Never	Once or twice	A few times	A few times, but less than half	About half the time	Most times	Every time

In the course of the past 4 weeks, how often have you washed your hands after going to the toilet? *(Please tick one box)*

Never	Once or twice	A few times	A few times, but less than half	About half the time	Most times	Every time

In the course of the past 4 weeks, how often have you taken extra supplements to maintain a healthy diet (e.g., vitamin tablets, protein drinks, creatine etc.)? *(Please tick one box)*

Never	Once or twice	A few times	A few times, but less than half the days	On about half the days	Most days	Almost everyday

In the course of the past 4 weeks, how often have you exercised regularly? *(Please tick one box)*

Never	Hardly ever	Very occasionally	Occasionally	A few times	Often	Very often

In the course of the past 4 weeks, how often have you planned work in advance to reduce stress? *(Please tick one box)*

Never	Hardly ever	Very occasionally	Occasionally	A few times	Often	Very often

In the course of the past 4 weeks, how often have you sat with the correct posture? *(Please tick one box)*

Never	Once or twice	A few times	A few times, but less than half the days	On about half the days	Most days	Almost everyday

In the course of the past 4 weeks, how often have you avoided foods high in sodium/salt (e.g., salted, pickled or smoked products)? *(Please tick one box)*

Not had any	Had once or twice	Had a few times	Had a few times, but less than half the days	Had on about half the days	Had most days	Had lots

In the course of the past 4 weeks, how often have you eaten sufficient foods with dietary fibre (roughage) (e.g., wholegrain cereals and bread, fruit and vegetables)? *(Please tick one box)*

Never	Once or twice	A few times	A few times, but less than half the days	On about half the days	Most days	Almost everyday

In the course of the past 4 weeks, how often have you eaten 5 portions of fruit or vegetables a day? *(Please tick one box)*

Never	Once or twice	A few times	A few times, but less than half the days	On about half the days	Most days	Almost everyday

Appendix 2 – Correlation Matrices, Chapter 2

Table 1

Correlation for behaviour: reducing calorie intake

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Calorie
Intention	.90	3.28	1.91	---					
Con	.80	4.60	1.78	.65**	---				
Aut	.77	5.16	1.72	.60**	.49**	---			
GNATint	.54			.11	.07	.05	---		
GNAText	.61			.08	-.06	-.03	.05	---	
Calorie		3.38	1.96	.64**	.53**	.54**	.09	-.04	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 2

Correlation for behaviour: Eating low fat foods

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Fat
Intention	.96	3.67	1.77	---					
Con	.80	4.66	1.77	.58**	---				
Aut	.78	6.13	1.70	.67**	.69**	---			
GNATint	.54			.08	.03	.09	---		
GNAText	.61			-.05	-.04	-.12	.05	---	
Fat		4.01	1.75	.65**	.44**	.42**	.03	.01	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table3

Correlation for behaviour: Wearing a seatbelt

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Belt
Intention	.96	6.32	1.21	---					
Con	.78	6.96	2.04	.47**	---				
Aut	.68	6.56	1.28	.21	.42**	---			
GNATint	.54			-.09	-.12	-.01	---		
GNAText	.61			-.02	-.03	.03	.05	---	
Belt		6.01	1.69	.45**	.08	.07	.09	-.09	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 4

Correlation for behaviour: Good night's sleep

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Slee
Intention	.85	5.79	1.34	---					
Con	.75	4.51	1.58	.37**	---				
Aut	.71	8.92	1.27	.60**	.42**	---			
GNATint	.54			-.011	.01	-.07	---		
GNAText	.61			.02	-.02	.09	.05	---	
Sleep		5.13	1.40	.04	-.17	.07	.05	-.09	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 5

Correlation for behaviour: Consuming within recommended limit of alcohol

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Alcohol
Intention	.86	4.63	1.99	---					
Con	.81	4.80	2.05	.43**	---				
Aut	.80	6.11	1.97	.68**	.58**	---			
GNATint	.54			-.15	-.07	-.03	---		
GNAText	.61			-.10	-.08	-.16	.05	---	
Alcohol		4.36	2.07	.15*	.23**	.22*	.012	-.23**	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 6

Correlation for behaviour: Using condoms

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Condoms
Intention	.95	5.16	2.24	---					
Con	.79	6.94	2.22	.59**	---				
Aut	.71	6.41	1.54	.42**	.57**	---			
GNATint	.54			-.02	-.12	.03	---		
GNAText	.61			-.00	-.06	-.14	.05	---	
Condoms		6.81	1.96	.18*	.04	-.17*	-.04	.07	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 7

Correlation for behaviour: Cleaning hands before handing food

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	HandsFood
Intention	.92	6.79	1.37	---					
Con	.84	7.10	2.18	.53**	---				
Aut	.69	7.19	1.70	.52**	.53**	---			
GNATint	.54			-.10	-.09	-.00	---		
GNAText	.61			.16	-.09	-.02	.05	---	
HandsFood		6.05	1.31	.52**	.36**	.50**	.03	-.02	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 8

Correlation for behaviour: Walks to relax

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Walk
Intention	.93	5.75	1.29	---					
Con	.72	4.51	1.58	.31**	---				
Aut	.71	8.92	1.27	.60**	.20*	---			
GNATint	.54			-.09	-.03	-.14	---		
GNAText	.61			-.03	-.12	-.02	.05	---	
Walk		4.83	1.57	.41**	.18*	.39**	-.04	-.04	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 9

Correlation for behaviour: Cleaning teeth

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Teeth
Intention	.89	6.81	0.63	---					
Con	.74	7.50	1.93	.12	---				
Aut	.73	7.77	1.55	.28**	.37**	---			
GNATint	.54			-.08	-.06	.13	---		
GNAText	.61			.02	-.10	-.13	.05	---	
Teeth		6.90	0.40	.29	-.12	.03	-.22*	-.03	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 10

Correlation for behaviour: Reducing eating junk food

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	JunkFood
Intention	.79	4.42	1.71	---					
Con	.76	5.96	1.95	.41**	---				
Aut	.71	6.07	1.63	.60**	.30**	---			
GNATint	.54			.13	-.01	.08	---		
GNAText	.61			.09	-.04	-.02	.05	---	
JunkFood		3.83	1.84	-.34**	-.21**	-.46**	.01	-.00	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 11

Correlation for behaviour: Reduce caffeine intake

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Caffeine
Intention	.94	3.07	1.77	---					
Con	.81	3.94	1.74	.58**	---				
Aut	.80	5.38	1.92	.80**	.70**	---			
GNATint	.54			-.04	.12	-.02	---		
GNAText	.61			-.08	.00	-.09	.05	---	
Caffeine		4.32	2.24	-.39**	-.13	-.44**	-.01	-.08	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 12

Correlation for behaviour: Use stairs instead of elevator/escalator

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Stairs
Intention	.96	5.23	1.51	---					
Con	.78	4.33	1.83	.30**	---				
Aut	.69	6.89	1.69	.64**	.20*	---			
GNATint	.54			-.08	.01	.08	---		
GNAText	.61			.10	.01	.19*	.05	---	
Stairs		5.21	1.75	.29**	.10	.31**	.05	.03	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 13

Correlation for behaviour: Clean hands after toilet

	Descriptives			Zero-Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Hands Toilet
Intention	.93	6.79	0.64	---					
Con	.70	7.83	1.82	.42**	---				
Aut	.68	7.53	1.64	.31**	.37**	---			
GNATint	.54			-.06	-.09	.01	---		
GNAText	.61			.07	-.09	-.10	.05	---	
HandsToilet		6.79	0.50	.69**	.20*	.26**	.02	-.02	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 14

Correlation for behaviour: Use supplements to maintain healthy diet

	Descriptives			Zero-Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Supplement
Intention	.78		2.16	---					
	3.18								
Con	.72	3.89	1.81	.66**	---				
Aut	.72		2.29	.87**	.72**	---			
	5.23								
GNATint	.54			.07	.06	.04	---		
GNAText	.61			-.05	-.05	-.13	.05	---	
Supplement		2.45	2.15	.73**	.54**	.64**	.10	.03	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 15

Correlation for behaviour: exercise regularly

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Exercise
Intention	.98	5.23	1.63	---					
Con	.78	6.31	2.00	.41**	---				
Aut	.77	7.88	1.78	.81**	.29*	---			
GNATint	.54			.10	.03	-.02	---		
GNAText	.61			.03	-.07	.02	.05	---	
Exercise		4.11	1.83	.55**	.26**	.45**	.08	-.01	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 16

Correlation for behaviour: Plan work to avoid stress

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	PlanWork
Intention	.94	5.48	1.34	---					
Con	.77	6.13	1.99	.26**	---				
Aut	.71	7.32	1.75	.48**	.38**	---			
GNATint	.54			-.03	-.07	.06	---		
GNAText	.61			-.05	-.07	-.03	.05	---	
PlanWork		4.79	1.55	.31**	.00	.17	.03	-.08	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 17

Correlation for behaviour: Sit with correct posture

	Descriptives			Zero Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Posture
Intention	.92	4.79	1.47	---					
Con	.77	4.96	1.84	.59**	---				
Aut	.74	6.35	1.70	.76**	.55**	---			
GNATint	.54			-.06	.10	.05	---		
GNAText	.61			-.09	-.00	-.06	.05	---	
Posture		4.07	1.62	.38**	.05	.36**	.10	-.14	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 18

Correlation for behaviour: avoid intake of sodium/salt

	Descriptives			Zero-Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	Sodium Salt
Intention	.90	4.23	1.64	---					
Con	.83	5.05	2.03	.56**	---				
Aut	.80	5.95	1.84	.81**	.68**	---			
GNATint	.54			.12	.14	.08	---		
GNAText	.61			-.02	-.04	-.12	.05	---	
SodiumSalt		4.54	2.01	-.37**	-.24**	-.46**	.04	.10	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 19

Correlation for behaviour: Eaten sufficient fibre

	Descriptives			Zero-order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	FoodFibre
Intention	.95	5.44	1.24	---					
Con	.81	5.23	2.01	.38**	---				
Aut	.75	7.81	1.61	.82**	.45**	---			
GNATint	.54			-.02	.01	-.01	---		
GNAText	.61			.04	-.05	-.03	.05	---	
FoodFibre		5.55	1.33	.28**	.22**	.38**	.04	.04	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Table 20

Correlation for behaviour: Eaten fruit and vegetables

	Descriptives			Zero-Order Correlations					
	alpha	Mean	SD	Intention	Con	Aut	GNATint	GNAText	FruitVeg
Intention	.91	5.40	1.42	---					
Con	.80	5.64	2.00	.38**	---				
Aut	.71	8.03	1.66	.82**	.50**	---			
GNATint	.54			.03	.15	.12	---		
GNAText	.61			-.13	-.06	-.12	.05	---	
FruitVeg		4.31	1.92	.57**	.20*	.55*	.13	-.00	---

Int = Behavioural intention; Con = controlled measure (explicit); Aut = autonomous measure (explicit).
GNATaut = autonomous GNAT; GNATcon = controlled GNAT. GNAT alphas are split-half reliability scores.
Note. * $p < .05$, ** $p < .01$

Appendix 3 – Instructions Given to Participants in Studies 3 and 4 (Chapter 4)

- **Implicit section:**

Load up the E-Prime tasks. After offering the instructions below, leave the room.

Say: *"you will now be given 3 quick computer tasks to complete. Each task is a measure of reaction time to words that appear on screen. For each task, there are instructions at the beginning to guide you through. When you have completed this computer task, open the door and I shall come in and begin the next one".*

- **Questionnaire section**

Hand participants the questionnaire.

Say: "I would like you to fill in this questionnaire, it should only take a few minutes, and further instructions are presented throughout".

The following instructions, for both the figure-tracing and the anagram tasks, are taken from (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Moller, Deci, & Ryan, 2006).

- **Figure Tracing - practise:**

Offer participant the practise trial diagrams. Allow them a maximum of 5minutes to complete tracing the figures. If they finish before, move on to the test section; if they do no finish after 5minutes, make sure they understand what the task entails, and then move on.

Say: "there is now a figure tracing task to complete. I will begin by giving you a practise diagram. ***The task requires you to trace the figure exactly without retracing any line once you have drawn it, and without taking your pencil off of the page.*** Please try as many times as you like, please show all working (i.e., don't try to trace it in your head first), do not cross out any mistakes and start each new try on a separate page"

- **Figure Tracing - Test**

Hand the participant the two test figures to trace.

Say: "I will now leave you to trace the following figures. The same rules apply as before"

Then say the following, exactly:

"You can take as much time and as many trials as you want. You will not be judged on the number of trials or the time you will take. You will be judged on whether or not you finish tracing the figure. If you wish to stop before you finish (i.e., solve the puzzle), please open the door and I shall be waiting outside".

Start the stopwatch, subtly!!

Leave the room. The maximum time they can take is 20minutes. If they have not left the room before this time, re-enter and tell them thank them for their persistence, and tell them the experiment has finished/move on to the implicit measures/questionnaire.

If they open the door before 20minutes, this is fine, record the time they stopped working (**subtly**) and move on/finish.

- **Anagram task**

Hand the participant the anagram sheet.

Say: "I will now leave you to work through the following anagrams.

Then say the following, exactly:

"You can take as much time and as many attempts as you want. You will not be judged on the number of attempts or the time you will take. You will be judged on whether or not you can complete them all. If you wish to stop before you finish (i.e., solve the puzzles), please open the door and I shall be waiting outside".

Start the stopwatch, subtly!!

Leave the room. The maximum time they can take is 20minutes. If they have not left the room before this time, re-enter and tell thank them for their persistence, and tell them the experiment has finished/move on to the implicit measures/questionnaire.

If they open the door before 20minutes, this is fine, record the time they stopped working (**subtly**) and move on/finish.

Appendix 4 – Questionnaires for Chapters 4, 5, and 6

YOUR OPINIONS ABOUT YOUR BEHAVIOUR

Thank you for agreeing to participate in our survey which asks your *opinions* about your participation in psychology studies. Everyone feels differently, so there are no right or wrong answers, we are interested in your *opinions*. Do not spend too long on any one statement and give the response that best describes your feelings. All responses are strictly *confidential*, and please answer *all the questions*. For each pass time/ behaviour please read all of the statements and CIRCLE A NUMBER **for each.**

Completion of anagram task

*(Remember to circle a number for **every** reason)*

Read the statements below and circle the number on the right that best describes your answer	**not at all true**			**somewhat true**			**very true**
1. While I was working on the task I was thinking about how much I enjoyed it	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. I did not feel at all nervous about doing the task	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3. I felt that it was my choice to do the task	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4. I think I am pretty good at this task.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5. I found the task very interesting	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6. I felt tense while doing the task	**1**	**2**	**3**	**4**	**5**	**6**	**7**

7. I think I did pretty well at this activity, compared to other students.	1	2	3	4	5	6	7
8. Doing the task was fun	1	2	3	4	5	6	7
9. I felt relaxed while doing the task	1	2	3	4	5	6	7
10. I enjoyed doing the task very much	1	2	3	4	5	6	7
11. I didn't really have a choice about doing the task.	1	2	3	4	5	6	7
12. I am satisfied with my performance at this task	1	2	3	4	5	6	7
13. I was anxious while doing the task.	1	2	3	4	5	6	7
14. I thought the task was very boring	1	2	3	4	5	6	7
15. I felt like I was doing what I wanted to do while I was working on the task	1	2	3	4	5	6	7
16. I felt pretty skilled at this task.	1	2	3	4	5	6	7
17. I thought the task was very interesting	1	2	3	4	5	6	7
18. I felt pressured while doing the task.	1	2	3	4	5	6	7
19. I felt like I had to do the task.	1	2	3	4	5	6	7
20. I would describe the task as very enjoyable.	1	2	3	4	5	6	7
21. I did the task because I had no choice.	1	2	3	4	5	6	7
22. After working at this task for awhile, I felt pretty competent	1	2	3	4	5	6	7

WHAT I AM LIKE

In this section, please read the pairs of statements, one pair at a time, and think about which statement within the pair seems more true for you. Indicate the degree to which statement A feels true, relative to the degree that Statement B feels true, on the 5-point scale shown after each pair of statements. If statement A feels completely true and statement B feels completely untrue, the appropriate response would be 1. If the two statements are equally true, the appropriate response would be a 3. If only statement B feels true, the appropriate response would be a 5; and so on.

1. A. I always feel like I choose the things I do.
   B. I sometimes feel that it's not really me choosing the things I do.

   Only A feels true 1 2 3 4 5 **Only B feels true**

2. A. My emotions sometimes seem alien to me.
   B. My emotions always seem to belong to me.

   Only A feels true 1 2 3 4 5 **Only B feels true**

3. A. I choose to do what I have to do.
   B. I do what I have to, but I don't feel like it is really my choice.

   Only A feels true 1 2 3 4 5 **Only B feels true**

4. A. I feel that I am rarely myself.
   B. I feel like I am always completely myself.

   Only A feels true 1 2 3 4 5 **Only B feels true**

5. A. I do what I do because it interests me.
   B. I do what I do because I have to.

   Only A feels true 1 2 3 4 5 **Only B feels true**

6. A. When I accomplish something, I often feel it wasn't really me who did it.
   B. When I accomplish something, I always feel it's me who did it.

Only A feels true	1	2	3	4	5	**Only B feels true**

7. A. I am free to do whatever I decide to do.
   B. What I do is often not what I'd choose to do.

Only A feels true	1	2	3	4	5	**Only B feels true**

8. A. My body sometimes feels like a stranger to me.
   B. My body always feels like me.

Only A feels true	1	2	3	4	5	**Only B feels true**

9. A. I feel pretty free to do whatever I choose to.
   B. I often do things that I don't choose to do.

Only A feels true	1	2	3	4	5	**Only B feels true**

10. A. Sometimes I look into the mirror and see a stranger.
    B. When I look into the mirror I see myself.

Only A feels true	1	2	3	4	5	**Only B feels true**

PART 3

These items pertain to a series of hypothetical sketches. Each sketch describes an incident and lists three ways of responding to it. Please read each sketch, imagine yourself in that situation, and then consider each of the possible responses. Think of each response option in terms of how likely it is that you would respond that way. (We all respond in a variety of ways to situations, and probably most or all responses are at least slightly likely for you.) If it is very unlikely that you would respond the way described in a given response, you should circle answer 1 or 2. If it is moderately likely, you would select a number in the mid range, and if it is very likely that you would respond as described, you would circle answer 6 or 7.

1. You have been offered a new position in a company where you have worked for some time. The first question that is likely to come to mind is:

a) What if I can't live up to the new responsibility?

1 2 3 4 5 6 7

very unlikely very likely

b) Will I make more at this position?

1 2 3 4 5 6 7

very unlikely very likely

c) I wonder if the new work will be interesting.

1 2 3 4 5 6 7

very unlikely very likely

2. You have a school-age daughter. On parents' night the teacher tells you that your daughter is doing poorly and doesn't seem involved in the work. You are likely to:

a) Talk it over with your daughter to understand further what the problem is.

1 2 3 4 5 6 7

very unlikely very likely

b) Scold her and hope she does better.

1 2 3 4 5 6 7

very unlikely very likely

c) Make sure she does the assignments, because she should be working harder.

1 2 3 4 5 6 7

very unlikely very likely

3. **You had a job interview several weeks ago. In the mail you received a form letter which states that the position has been filled. It is likely that you might think:**

a) It's not what you know, but who you know.

1 2 3 4 5 6 7

very unlikely very likely

b) I'm probably not good enough for the job.

1 2 3 4 5 6 7

very unlikely very likely

c) Somehow they didn't see my qualifications as matching their needs.

1 2 3 4 5 6 7

very unlikely very likely

4. You are a plant supervisor and have been charged with the task of allotting coffee breaks to three workers who cannot all break at once. You would likely handle this by:

a) Telling the three workers the situation and having them work with you on the schedule.

1 2 3 4 5 6 7

very unlikely very likely

b) Simply assigning times that each can break to avoid any problems.

1 2 3 4 5 6 7

very unlikely very likely

c) Find out from someone in authority what to do or do what was done in the past.

1 2 3 4 5 6 7

very unlikely very likely

5. A close (same-sex) friend of yours has been moody lately, and a couple of times has become very angry with you over "nothing." You might:

a) Share your observations with him/her and try to find out what is going on for him/her.

1 2 3 4 5 6 7

very unlikely very likely

b) Ignore it because there's not much you can do about it anyway.

1 2 3 4 5 6 7

very unlikely very likely

c) Tell him/her that you're willing to spend time together if and only if he/she makes more effort to control him/herself.

1 2 3 4 5 6 7

very unlikely very likely

6. You have just received the results of a test you took, and you discovered that you did very poorly. Your initial reaction is likely to be:

a) "I can't do anything right," and feel sad.

1 2 3 4 5 6 7

very unlikely very likely

b) "I wonder how it is I did so poorly," and feel disappointed.

1 2 3 4 5 6 7

very unlikely very likely

c) "That stupid test doesn't show anything," and feel angry.

1 2 3 4 5 6 7

very unlikely very likely

7. You have been invited to a large party where you know very few people. As you look forward to the evening, you would likely expect that:

a) You'll try to fit in with whatever is happening in order to have a good time and not look bad.

1 2 3 4 5 6 7

very unlikely very likely

b) You'll find some people with whom you can relate.

1 2 3 4 5 6 7

very unlikely very likely

c) You'll probably feel somewhat isolated and unnoticed.

1 2 3 4 5 6 7

very unlikely very likely

8. You are asked to plan a picnic for yourself and your fellow employees. Your style for approaching this project could most likely be characterized as:

a) Take charge: that is, you would make most of the major decisions yourself.

1 2 3 4 5 6 7

very unlikely very likely

b) Follow precedent: you're not really up to the task so you'd do it the way it's been done before.

1 2 3 4 5 6 7

very unlikely very likely

c) Seek participation: get inputs from others who want to make them before you make the final plans.

1 2 3 4 5 6 7

very unlikely very likely

9. Recently a position opened up at your place of work that could have meant a promotion for you. However, a person you work with was offered the job rather than you. In evaluating the situation, you're likely to think:

a) You didn't really expect the job; you frequently get passed over.

1 2 3 4 5 6 7

very unlikely very likely

b) The other person probably "did the right things" politically to get the job.

1 2 3 4 5 6 7

very unlikely very likely

c) You would probably take a look at factors in your own performance that led you to be passed over.

1 2 3 4 5 6 7

very unlikely very likely

10.You are embarking on a new career. The most important consideration is likely to be:

a) Whether you can do the work without getting in over your head.

1 2 3 4 5 6 7

very unlikely very likely

b) How interested you are in that kind of work.

1 2 3 4 5 6 7

very unlikely very likely

c) Whether there are good possibilities for advancement.

1 2 3 4 5 6 7

very unlikely very likely

11. A woman who works for you has generally done an adequate job. However, for the past two weeks her work has not been up to par and she appears to be less actively interested in her work. Your reaction is likely to be:

a) Tell her that her work is below what is expected and that she should start working harder.

1 2 3 4 5 6 7

very unlikely very likely

b) Ask her about the problem and let her know you are available to help work it out.

1 2 3 4 5 6 7

very unlikely very likely

c) It's hard to know what to do to get her straightened out.

1 2 3 4 5 6 7

very unlikely very likely

12. Your company has promoted you to a position in a city far from your present location. As you think about the move you would probably:

a) Feel interested in the new challenge and a little nervous at the same time.

1 2 3 4 5 6 7

very unlikely very likely

b) Feel excited about the higher status and salary that is involved.

1 2 3 4 5 6 7

very unlikely very likely

c) Feel stressed and anxious about the upcoming changes.

1 2 3 4 5 6 7

very unlikely very likely

Appendix 5 – Anagrams used in Chapter 4 and 6

Instructions (Given to participants to read and complete):

Jumbles is a type of word search anagram where if you re-arrange correctly **all** the letters in the given non-words, you will find a real word related with **nature.**

For example: **lbujme → jumble**

1. slaanim →
2. dwin →
3. eplap →
4. lujgne →
5. dwil →
6. sbdir →
7. akle →
8. ushb →
9. aevsle →
10. licnmga →
11. uosdrtoo →
12. gmiancp →
13. yegnox →
14. scndtreotiu →
15. aceep →
16. odsg →
17. elppeo →
18. sckud →
19. cpnicsi →
20. ocgoyel →
21. atnpsl →
22. vemnietnnro →
23. lotpounli →
24. iusensr →
25. hfsi →
26. irentaofrss →
27. eoflrw →
28. iresvr →
29. ofrtes →
30. roskc →
31. rgssa
32. ideseas →
33. rngee →
34. qrirlues →
35. lshee →
36. ofrtes →
37. roskc →
38. rgssa
39. ideseas →
40. rngee →
41. qrirlues →